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July 31, 1924

Engineering News-Record

Blasting a Highway Out of a 200-foot Cliff Along California's Rugged Coast

THREE construction views of the same spot along the San Juan—Oxnard road, where 100,000 cubic yards of solid rock were excavated in less than 4,000 feet of a 30-foot road.

yton Concrete Building is 274 feet High

Producing Artificial Ground Water Frankfort, Germany

Tunneling Methods Volcanic Formations

ifficult Surveys and Deep Cuts on ew Coast Highway

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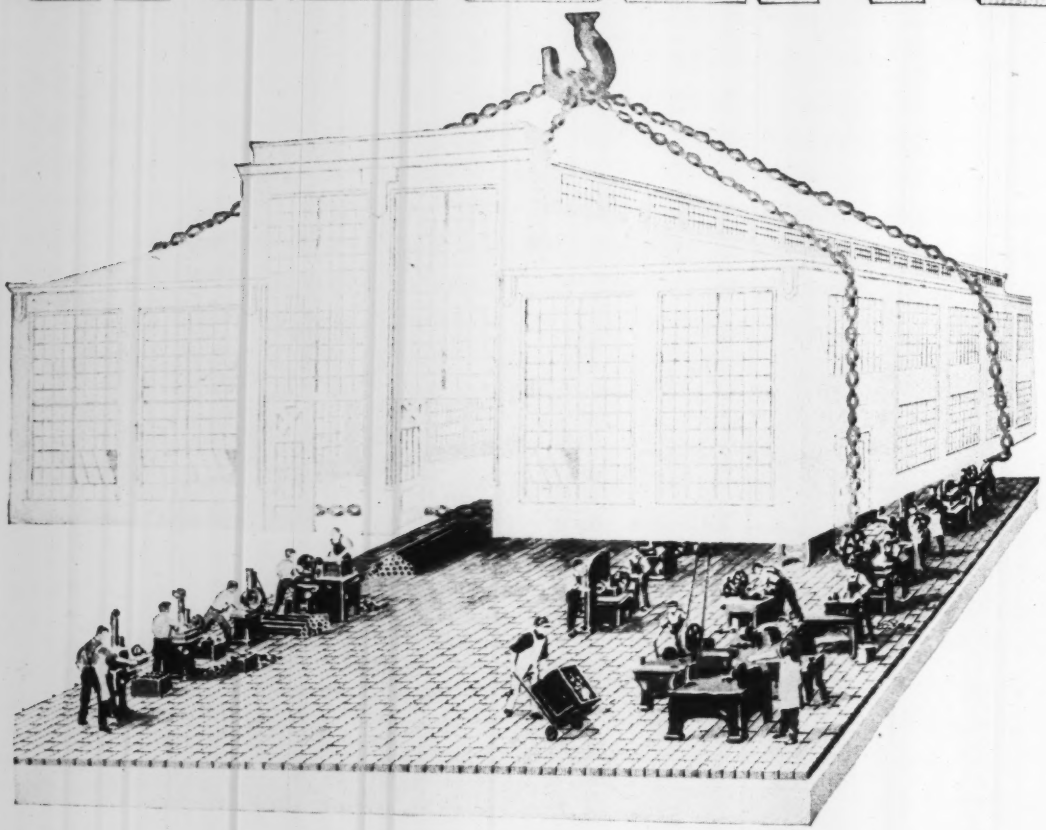

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ENGINEERING NEWS-RECORD

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

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John H. Dunlap

FEW positions in the engineering profession are more difficult to fill than that of secretary of the American Society of Civil Engineers. Knowledge of the technique of engineering must be combined with an executive ability, a friendly spirit, a diplomatic manner, an understanding of human actions and motives and a precision of judgment. For a young man, John Dunlap possessed these qualities to an unusual degree. He grew with his job. In the two years since he was chosen to compose an unhappy difference in the society and on its board, he came to be accepted by all as a permanency—as one who could be looked to for workmanlike execution of the daily task and for clear vision of future development. In his sudden taking away the society, and through it the profession, loses a powerful influence toward its upbuilding.

Make Repairs in Winter

CO-ORDINATION of building repair work and new construction so that repairs will be conducted largely at the time of year when new construction employs least labor is passing from academic discussion into actual practice. For some time building congresses have been recommending action. The most notable cases perhaps are Philadelphia, New York and Boston. These congresses are primarily associations of building contractors and while influential their recommendations cannot bring concrete action. This rests with building owners. Recently they have begun to take action. Word comes that the Portland Association of Building Owners and Managers of Portland, Ore., has officially decided to defer until winter all usual spring and summer maintenance and repairs which it is possible to postpone. Early in June the Building Owners and Managers Association of Philadelphia took similar action. Both organizations base their action on surveys which have disclosed that much repair work now done in summer can be done "just as easily and perhaps more efficiently during the slack winter period."

A Fair Method Growing in Favor

ASSESSMENTS for benefits is a method of paying for municipal improvements that has long stood the test of time. Used at first for highways and street openings, grading and surfacing, it was extended later to lateral sewers, district sewers and sometimes outfall sewers and treatment works as well. Here and there the cost of water mains—generally extensions rather than the entire original distribution system—has been assessed on abutting property, but as a rule this has not followed regular assessment-for-benefit procedure. There have been scattered instances of raising money for parks by special assessments. A few months back, property owners along a portion of the Sixth Avenue Elevated Railway, New York City, joined in a protest for getting rid of the elevated and at the same time providing better transit facilities by building a subway, on the assessment plan and stimulated presumably by the Sixth Avenue project property-owners and residents along First Avenue, New York City, have within a few days filed a petition for a subway on that thoroughfare, in which some of the property owners expressed a willingness to bear a part of the cost of construction. Besides being a great aid in solving the growing problems of municipal finance this assessment-for-benefit method applies an acid test at the very outset of a project, since the first step in the plan is a petition for the improvement, signed with the knowledge that the petitioner beneficiaries must foot at least a large part of the bill. At later stages, all who are liable to assessment have a right to be heard, and as a rule if a representative majority of the property in the assessment district object that ends the project.

Never Stood for Parliament

IT SEEMS to be taken for granted in England that any man who receives national distinction in art, letters, business, industry or engineering is entitled to "stand" for Parliament. Many finally sit there, although how many engineers are included in this number we cannot say. These reflections come from reading a notable editorial appraisal in London *Engineering* of the late Lord Pirrie, who became chief draftsman of the shipbuilding firm of Harland & Wolff at 22 years of age, junior partner at 27, and was subsequently a force in the White Star Line and other British shipping interests. In the course of its appreciation, *Engineering* rather casually remarks: "He never stood for Parliament." Imagine inserting in a memoir of an American engineer: "He never ran for Congress." Such a phrase might be found in an obituary of an American lawyer but certainly not of a member of any of the other professions no matter how learned. Compared with Great Britain, America gives little recognition to distinction in the arts in teaching or in engineering when selecting representatives in legislative halls, or in filling administrative positions. This fault, if fault it be, lies primarily with the people at large, but some of it should fall upon the various professions *other than law;* especially upon the engineering profession, many of the members of which are well fitted by education and experience to become valuable public servants.

Garbage Disposal Practice

WHETHER or not garbage disposal methods in municipalities having city managers may be considered as representative of practice throughout the country in places of the same general range of size, the data from 100 manager cities summarized elsewhere in this issue is of interest. Most of the places listed are rather small—a fact that makes some of the

things shown by the summaries all the more notable and suggests that these places with managers may be doing better in the way of garbage disposal than other communities of the same size throughout the country. It is encouraging to find that 54 of the 100 cities do their own work of garbage collection, that 87 of the 100 places report fly-tight garbage containers in use, that 60 per cent collect garbage twice a week or oftener in the residence districts, while in the business districts 66 per cent have a daily service and 77 per cent have garbage collection at least twice a week. Taking into account the relative smallness of most of the places listed, it is notable that a little over half report the use of "trucks," meaning motor-drawn vehicles. The methods of final disposal reported are satisfactory as a rule. Thus, only 14 of the 100 places report disposal by dumping. Some form of utilization is reported by 38 places; 32 hog feeding, 4 "fertilizer" and 2 reduction. It should be remembered that all the figures are quantitative rather than qualitative and that even as quantitative few of them show what percentage of the population is served—facts which, in most of the places, probably no one knows.

Contractors' Bond Conference

LESS than two months remains before the first committee reports are due according to the program of the joint conference on surety bonding organized by contractors and surety companies last month. The time is all too brief for consideration of and even tentative decision on the various questions raised in the outlines for committee procedure and the work must be set about assiduously if worthy results are to be reported in September. The first meeting of the conference in June was remarkably successful. It was anticipated that in this opening session the members would do scarcely more than get to know each other. They got much further. The whole problem was made clear by unusually frank discussion. The effective result was the creation of three committees to consider and to report on three groups of subjects comprising nine separate questions. It is these reports which are expected at the September meeting. No one probably is sanguine enough to expect that final conclusions can be arrived at in the first reports. It is decidedly important, however, that these reports shall show that progress has been made. Unless progress is made there will be a slacking down of interest which will set back the entire work. It must not be forgotten that on both sides the conference was undertaken as a gentlemanly action with the mental reservation that a square fight would best settle the dispute. In the light of all facts the duty of the conference committees is clear. Now that they have the outlines of their tasks the work should be attacked promptly and prosecuted actively.

Filter Men Study Alum Mixing

IF RESEARCHERS in sanitary chemistry were to choose an emblem at the present time it would certainly be the mixing spoon. The sewage treatment experimenters have been making studies of mixing ever since the activated-sludge process came to the front. In the waterworks field, alum agitation to get the most efficient coagulation possible out of the alum used is the problem. Experiments with mechanical stirrers, such as those used at Sacramento (*Engineering News-Record*, June 2, 1921, p. 924) and more recently, those reported by Charles R. Cox at Reading, Pa. (*Engineering News-Record*, July 17, p. 101) seem to have set up a different standard from that by which most of the older plants of the country have been designed. Briefly, it is that moderate mixing continued for a long period rather than violent agitation for a short time is the best procedure. The experiments by J. W. Ellms at Milwaukee, where he utilized the hydraulic jump, is an extreme example of the short, speedy type of mixing. In all probability, no one method is best. To provide in the design for the prolonged, moderate method requires such a vastly different layout than does the speedy method that engineers designing a plant for a particular water should be thoroughly cognizant of the method best fitted to the water in question.

One caution to those reading the Cox article is apropos. His statement that diffusion is very rapid is hardly correct when applied to full-size basins. Relatively, diffusion is a slow process, as brought out by Dr. A. M. Buswell in his discussion of aeration versus agitation of sewage in *Engineering News-Record*, May 10, 1923, p. 835. Experiments on diffusion of salt through the rectangular baffled and unbaffled basins of the Spring Garden Testing Station at Philadelphia in 1901 proved the slow speed of diffusion. The New York Metropolitan Sewerage Commission pumped thousands of gallons of aniline dyes from tank barges down to the bottom of New York Bay near the Statue of Liberty but an observer stationed in the torch of the statue never saw any discoloration on the surface. Diffusion is relatively slow and filter operators would have difficulty in getting alum in intimate contact with all portions of the water if they depended on it alone.

Designers proposing to use the results of these various miniature experiments should augment the valuable information thus obtained by observations of operators on full-size plants. Plenty of the latter of all kinds and descriptions exist but altogether too little information of what they can do and are doing gets publicity, particularly if the results are not favorable.

Price Policies and Fair Dealing

RARELY has a decision on industrial-corporation affairs presented so broadly important an aspect as the Pittsburgh-plus decision of the Federal Trade Commission handed down last week. Whether finally upheld or overthrown, it will rank as an epoch-making pronouncement. Viewed as a whole it may be seen to deal with basic questions of marketing and pricing under conditions of monopoly or incomplete competition. The principle suggested by the commission's findings is that legitimate price and marketing practices must meet the test of fairness; and though this principle may seem elementary and axiomatic its specific application in a case of great magnitude is nevertheless momentous.

The case, it is true, was not concerned with the inherent fairness of a particular price or system of prices. It asked only whether certain prices were *equally* fair, or whether on the contrary they discriminated between different buyers and different localities. In effect, the only defense the steel corporation appears to have for the system is that it benefits the steel-consuming public at large whatever be the effect on the consumer at unfavorable points. In other words it considers Pittsburgh in the light of a steel producing

reservoir the level of which it is to the interest of the public to maintain, by artificial means if necessary, so that an even supply of steel at an approximately stable price can be assured. The commission brushes this aside and holds that the prices set by the system are obviously discriminatory, and therefore unlawful. But it holds further that this discrimination not only injures those discriminated against but that it actually injures the public at large, partly possibly by a raised general level of price but mainly by producing unhealthy conditions in other industries than that of steel making, so that the makers and the buyers of farm machinery, of bolts, of wire, are affected and the spread of manufacturing industries is throttled.

The essential element in the commission's case is fairness. Every finding in the decision makes spoken or unspoken reference to fairness. Artificial means of maintaining an industry are not to be permitted. The law of supply and demand and the consequences of competition must be allowed to have free play.

In the findings which underlie its order the commission convicts the steel corporation in specific terms of unfair dealing. The findings are severe and unequivocating in their language on this point, and cite reiterated proof of unfairness. Since the corporation dominates its field and therefore is in the main a free agent, it was not compelled to follow practices established by others or to resort to undesirable price systems as a means of meeting competition. Indeed, the commission says that the price system under indictment was able to exist only because of the lack of adequate competition in the steel and steel-products field, and that it had the effect of controlling competition still more. In short, the picture drawn by the findings is that the corporation chose to retain and extend an unfair price system despite the fact that it was aware or might have been aware of its discriminatory and injurious effects, because it considered that the practice was necessary to the "orderly conduct" of the steel business. And the corporation saw fit to determine for itself, regardless of established public policy, what that "orderly conduct" meant and required.

The implications of the case are rather disturbing to one's faith in the ideals and corporate methods of our industrial establishment. In condemning the price system unreservedly, the commission lays a charge against either the wisdom or the public spirit of a corporation which many people have ranked among the best of the country's industrial organizations. The charge is not detailed, but several possibilities suggest themselves: that those at the helm of the corporation's affairs were unable to perceive the defects of the price system which has now been condemned, or that they considered themselves obligated solely to their corporation and not at all to the public. Yet there is oft-quoted principle that the public is a silent partner in every large corporation, and leaders of large corporations have often given voice to their belief that they are in part trustees of the public interest.

Whatever may be the ultimate reasons and motives for the survival of the Pittsburgh-plus practice, the commission's analysis of the situation and its conclusion that the practice should be abolished is an argument for the continuing—and probably growing—need for regulation of corporate enterprise by direct representatives of the public. Such beliefs as may have grown up that wise corporate management would tend to eliminate the need for regulatory action find no support in the present case.

Water Power Not a Cure-All

NO BETTER evidence of the fallacy of the claim that huge concentrated power plants, either hydroelectric or mine-mouth steam, will of themselves make a great reduction in the general cost of power has ever been given than in the Super-Power Studies abstracted in this issue. A considerable portion of the studies is devoted to an estimate of the cost in mills per kilowatt-hour of electrical power generated in one or more different ways at important manufacturing centers of the northeastern states. Figures for the cost of two or more of the possible ways of providing power in these areas are given on a map which accompanies the report. The methods considered are only those which it is reasonable to expect will be used in the future. No estimates of the cost of plant-at-mine power at Buffalo, N. Y., for instance, or of St. Lawrence power at Richmond, Va., are given. The figures that are given will be eye-openers to many people. In and around New York City, local steam power and a combination of local steam and local hydro can successfully compete against plant-at-mine power and are not far in excess of the cost of local steam combined with St. Lawrence or Niagara power. Even at Philadelphia or Baltimore plant-at-mine power has little if any advantage over local steam or the combination of local steam and local hydro while at Pittsburgh, all three are about on a par.

The reason for this apparent discrepancy lies chiefly in three things—the high cost of transmission, the limit on the location of mouth-of-mine plants imposed by the great volume of condensing water such plants need, and the fact that the cost of fuel in the region to which plant-at-mine power can be transmitted economically is so low that local steam plants can successfully compete against the larger plant. Moreover, another condition which is unfavorable to St. Lawrence power or plant-at-mine power is that as these plants must be operated on a high load factor, they can only carry the base load in any community, leaving the expensive peak loads to be carried by local steam plants at increased operating cost, with the result that the cost of local steam power is greater when the local plant is operated in conjunction with the distant plant than when carrying the entire load, and consequently the cost of power is greater than it would first appear to be when making an estimate of the cost of power with the two sources combined.

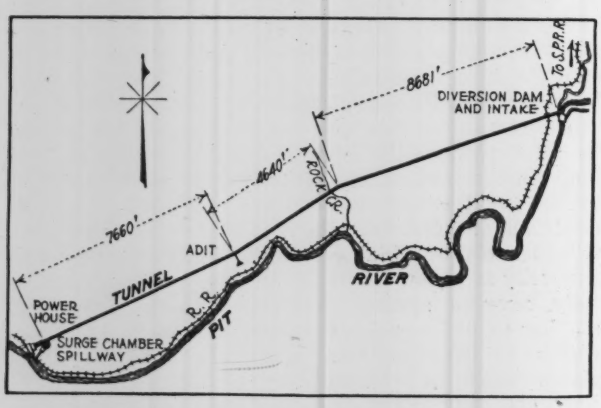
These facts the people should know. Power is being made a political issue. There is a form of political philosophy which holds that power can be generated by falling water and distributed to the home and factory for practically nothing—certainly for less than when steam is used as the generating force. This is a philosophy founded on ignorance or worse and its propagation is vicious in the extreme. The figures on the relative costs of power from different sources are sufficient indication of the complications of power cost to the consumer and an answer to those who assume that to insure cheap power it is only necessary for the state to develop its water powers.

Tunneling in Volcanic Formations on Pit River Project

Wall Plate Drifts and Top Center Headings Used as Rock Varies from Friable Tuff to Hard Lava—Air Shovel With ½-Cu.Yd. Bucket Is Preferred Mucking Method—Bonus System Increases Progress

UNLIKE THE HARD rock common to many western power tunnels, volcanic tuff is being encountered all along the 4-mile length of the Pit River No. 3 tunnel now under construction by the Pacific Gas & Electric Co. in northern California, and driving and mucking methods are being developed accordingly. Both the wall plate drift and the top center heading methods are used in advancing the face, and various methods of mucking have been tried in different formations, with a decided preference for air-driven steam shovels. Due to the constant variation in the formation the methods of carrying on the work are adapted to frequent changes as described in the following. Previous reference to the Pit River chain of developments as a whole appeared in *Engineering News-Record*, Oct. 13, 1923, p. 605, and progress on the Pit No. 3 project was reported Nov. 29, 1923, p. 904.

At the outset an experiment was made by contracting a 2,000-ft. length of this tunnel while company forces worked at two other headings. The idea was that if the contract plan was satisfactory contracts would be awarded later for additional footage, or the company

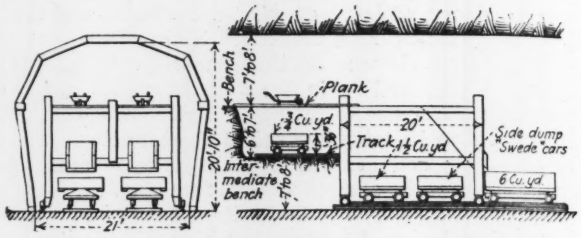


LOCATION OF TUNNEL, ADITS, RAILROAD AND RIVER

could take over the work without dispute on the completion of this first unit. The contract price for driving and timbering was $91 per foot. On account of the widely varying formations and hence the uncertainty of cost, after the completion of the contract the contractor decided that further work on the same contract basis was inadvisable. All six headings of the tunnel are therefore now being driven by the company's own construction organization.

The tunnel has a 20x20-ft. horseshoe section and requires timbering throughout, 8x12-in. sets 5 ft. apart with a five-segment arch being sufficient. As soon as driving is finished the tunnel is to be lined with concrete having a minimum thickness of 8 in. in front of timbers and 12 in. in the invert, reinforced by steel rods with a minimum diameter of ¾ in. Three 8-hr. shifts of driving crews are used at all headings, and the objective in organizing crews, material and equipment is a complete cycle of drilling, shooting and mucking operations with an average 5-ft. advance in each shift.

Wall Plate Drifts—In loose rock formation and in bad ground generally the best progress has been made by the use of wall plate drifts because timbering can be put in to best advantage in headings of minimum size. These drifts are usually timbered with sets 5 ft. apart placed so as to be a part of the permanent tim-



ARRANGEMENT OF MUCKING JUMBO

Wheelbarrows on the upper level dump into a bin; ¾-cu.yd. cars on intermediate bench dump into 1½-cu.yd. cars on main tunnel tracks.

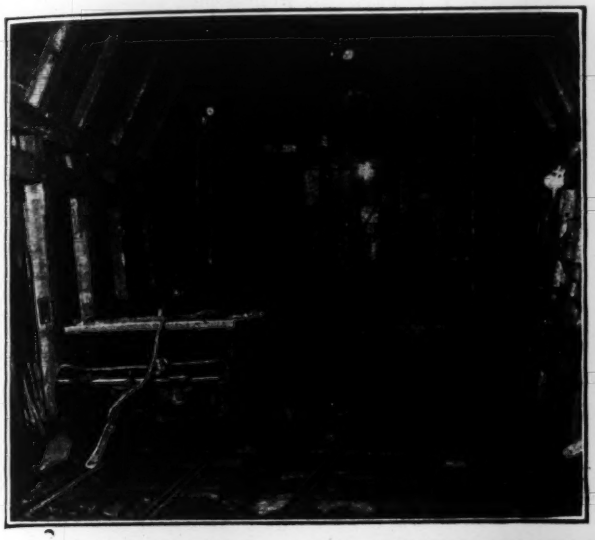
bering. At times, when the ground is particularly bad, it is necessary to use temporary timbering so that the permanent sets will come between. The great variety of rock conditions encountered is taxing the skill of the best foremen in securing the desired progress in these drifts. As harder formations are met the face can be carried farther ahead of the timbering; in loose rock attention is concentrated on the timbering because the face can be easily broken down. However, where these drifts are used the material is usually loose and hence timbering in them becomes the limiting factor in the progress of the heading.

In badly fractured rock where clay seams occur, a stick and a half of powder in one jackhammer hole (1½ in. diam.) sometimes sufficiently loosens up the entire heading. Again such hard lava is encountered that as many as 11 Leyner drill holes (2 in. diam.) are required. In some headings the foremen change occasionally from jackhammers to Leyner drills or vice versa, according to the rock encountered. Other foremen believe that too much time is lost in frequent changing of drills and steel without commensurate advantage, and insist that the crews work steadily with one type or the other.

A disadvantage in wall plate drifts is that since they are kept about 50 ft. ahead of the face, shots placed to advance the face frequently knock out the timbers in the drifts. Delay thus caused is serious, because where wall plate drifts are used they are the limiting factor in advance of the finished heading. Although interference of this sort could be avoided by using light charges in the ring face, foremen prefer to work pretty close to the limit and will risk shooting out drift timbers occasionally rather than let the work at the face get behind. Care is necessary in loading holes in this face; with both sides cut by the wall plate drifts the same amount of powder will move more yardage here than in a heading. Moreover, where pockets of loose material are encountered, these are likely to "blow out" into the wall plate drifts.

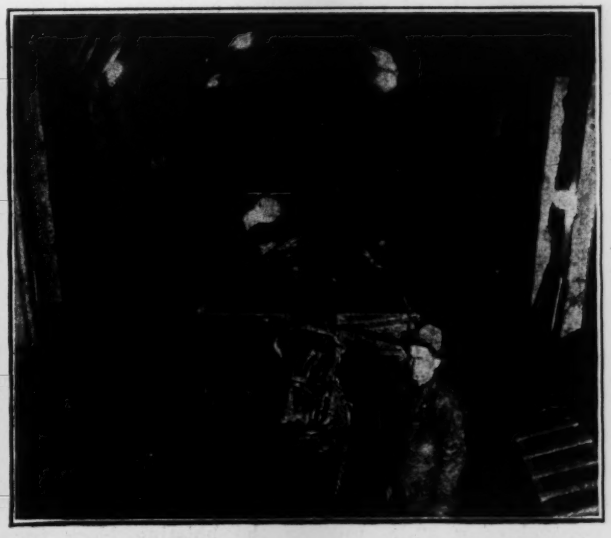
Top Center Heading—In formations solid enough to stand up well, i.e., where temporary timber supports

10 ft. apart suffice, the center top heading method of driving is preferred because it affords more working space for the men and faster progress can be made than where wall plate drifts are used. Fifteen men constitute a complete crew for the bench, the number being the same for wall plate drifts and for center top heading. This crew includes 8 miners, 6 muckers and one shifter.



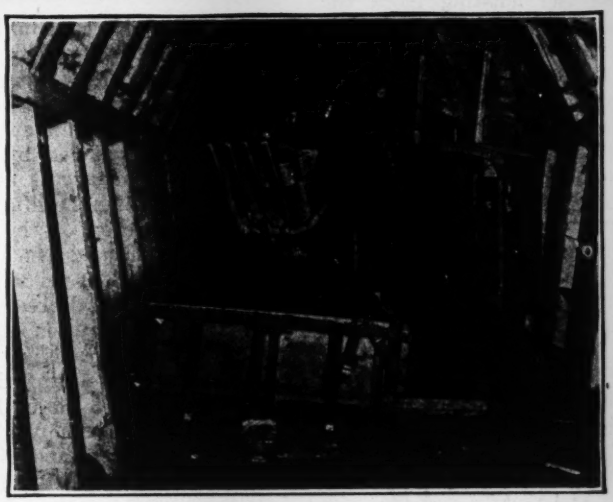
REAR VIEW OF JUMBO MUCKING CAR

Note simple arrangement of "Swede" side-dump cars. These cars, of 1¼ cu.yd. capacity, are loaded either from wheelbarrows or from the jumbo bin.



BOTTOM TRAP METHOD OF MUCKING

This plan was not favored and was used only a short while. Its disadvantages were the necessity for advancing three small headings and the choking of the trap with blocky material.



MUCKING WITH AIR SHOVEL

Men are working back of dipper, on the bench. This 6-cu. yd. car could not go alongside the shovel; later cars of the same design and capacity, but 8 in. narrower, were run alongside the shovel and thus brought closer to bench face.

The center top heading is usually about 6x8 ft. in size and an effort is made to keep this about 25 ft. ahead of the bench and to maintain a bench length of about 25 ft. This practice gives (1) adequate room for winging out from center heading to the wall plates; (2) sufficient space for storing timbers and packing on the bench; and (3) a reasonably short wheelbarrow haul for muckers dumping over the face of the bench. In winging out, the holes are driven ahead at a slight angle and are loaded lightly. These shots are usually made without much overbreak despite the widely varying formation.

Drilling Practice—The frequent and sudden change from one rock hardness to another has undoubtedly slowed down progress to some extent and has made it necessary to keep the drill sharpeners well posted as to conditions at the heading. The very hard lavas call for a hard temper in drills while in the rock with an excess of seams it is of primary importance that the bit make a hole not much larger than the drill steel. In the seamy rock a hole much larger than the drill steel, whether caused by lack of skill in operating the drill or by a bit unsuited to the work, causes almost continual wedging or "plugging."

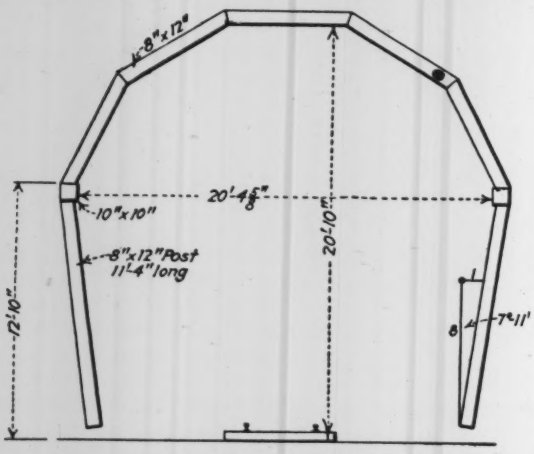
Carr bits are used almost exclusively in agglomerate and in material that ravels badly. To reduce plugging and wedging, the water hole in the center of the cutting edge is omitted and in its place one or two holes are drilled just back of the bit to the central water passage. These holes are put in on a slight angle so the water will be directed forward as it comes out. Their use has been found effective in washing away chips that would otherwise tend to wedge the bit. The bits are made by hand and sharpened by machine.

Mucking with Air-Shovels—Since these tunnels have a clear width of 20 ft. inside the timbering and require the handling of about 20 cu.yd. of muck per lineal foot, the company believed that air-driven shovels would be the most economical method of loading the muck at the tunnel headings. Three Erie "tunnel muckers" operating on crawler treads and equipped with ½-cu.yds. buckets were therefore purchased and another one has more recently been added. The first of these did not reach the job until after the headings had been advanced some distance by hand methods, in fact not until the contract had been finished and the work taken over by company forces. Hence most of the tunnel foremen, being reluctant to make any change in methods, were opposed to the introduction of power equipment for mucking. This opposition was the more difficult to overcome because the shovels as pur-

chased were not suited to the work and at first made a comparatively poor showing. It was only after actually operating them and discovering by trial what changes in the mechanism were necessary that the power company was able to adapt them to the work and get entirely satisfactory operation.

However, a month's operation of the shovels, after the necessary changes had been made, clearly showed the superiority of power loading equipment and the entire organization became enthusiastic over the use of the shovels. The changes necessary to adapt the shovels to this work were as follows: (1) The dipper sticks were lengthened from 8½ to 10½ ft. thus making it possible for the shovel to remain on one side of the tunnel and load from the far side of the bench face into 6-cu.yd. cars standing alongside the shovels. Prior to this change the 8½-ft. dipper stick would not reach all the way across the face, and when the shovel was moved over to reach the far side, clearance was cut down so that muck cars could not come alongside. In making the boom longer, oak was substituted for the pine in the original stick with a resultant increase in rigidity. (2) The teeth on the bucket were spaced farther apart so they could handle the rock more effectively. New buckets, of which four were ordered, were to be made stronger, shallower and wider and were to have the front curved outward about 2 in. at the center to permit the passage of larger rock through the bucket and to facilitate filling to the full depth. (3) By the removal of a 22-in. link on the hoisting block the bucket can now be brought close to the boom end, thus materially decreasing the space in which the shovel can work effectively. With the boom at a 55-deg. angle the shovel swings with an overall clearance of 18 ft.

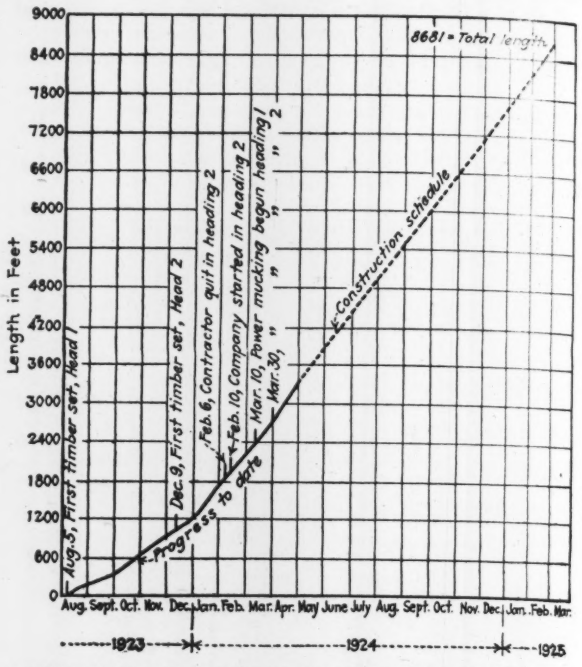
Although other minor details were rearranged, these three items were those considered essential to making the shovels workable on this job. However, experience



CROSS-SECTION OF TUNNEL BEFORE PLACING CONCRETE LINING

has brought out the observation that their capacity might as well be increased by the use of a larger bucket, which would, of course, have to be balanced by an increased counterweight. That change is not being considered on this job because the present capacity of the shovels is sufficient to handle the muck as fast as the headings can be advanced.

The use of air shovels substitutes mechanical means for hand labor on one-third the work of driving the



METHOD OF CHARTING PROGRESS IN EACH SECTION
Similar records for each of the four sections combine progress on the two headings in each section, thus showing on a single curve the rate of progress toward holing through.

tunnel. This decrease in the number of muckers required materially simplifies the operation as a whole by reducing the risk of labor troubles and simplifying camp operation and transportation, but more than all this it makes possible a speed of mucking greater than could be accomplished by the maximum number of muckers that could work at the face.

As organized in headings where no shovels are in use, the muck crew on the floor of the tunnel consists of six men each paid $4.50 per shift. The shovel, with one operator at $10 per shift, aided by one mucker at $4.50 per day thus decreased the crew by six men and makes it possible, when occasion arises, to handle the muck much more rapidly. It is estimated that if the headings could be advanced that fast these air shovels could muck 6 to 8 ft. of heading progress per shift. With these shovels the wheelbarrow haul on the bench is shortened, larger and higher cars are used to haul the muck out of the tunnel and there is no need for dragging a 300-lb. slick sheet into place before shooting, as is done in hand mucking. Also the overhead scaffolding for wheelbarrow runways is eliminated.

The shovels are the "merry-go-round" type with steam boiler and fuel bins replaced by cast-iron counterweights which balance the loaded bucket. The counterweights also serve as "armor" that makes it unnecessary for the shovel to move far back during shooting; the shovel is turned with this armored rear end toward the heading and is moved back 10 to 20 ft. from the toe of the bench face. This saves much time and thus far no damage to the shovels has resulted.

In the main the driving mechanism on these shovels is the same as that supplied for steam power, but larger cylinders were substituted to give the same power output with compressed air at 90 lb. per square inch as would be obtained with the standard steam cylinder under 125 lb.

The crawler treads are 18 in. wide and the base on which the shovel makes contact with the ground is 8 ft. square. Compressed air for operation is supplied (normally at 100 lb. per square inch) through a 1½-in. intake. The estimated air consumption during operation is 500 cu.ft. per minute.

Other Methods of Mucking—Because of the late arrival of the shovels, a large part of the footage thus far done on this job has been mucked by hand, wheelbarrows being used to dump muck from the drifts or ring over the bench face and six muckers working shoulder to shoulder on the tunnel floor shoveling into muck cars. Under this plan no more than six men could work at a time, and the delays incidental to changing cars held back the work, and in shooting the face of the bench as well as in breaking up the material generally it was necessary to work the muck down to small sizes to facilitate moving it by hand. With the usual rate of replacing filled cars, the hand mucking plan permits of loading 125 to 250 cu.yd. per shift.

In an endeavor to simplify and speed up mucking without machines several methods of trapping from the bench directly into cars were developed. The first of these was to drift into the bench face and use a bottom trap. This worked well in fine material only; blocky material frequently choked the trap and progress was slow. Two other methods of loading by gravity, however, met with better success and are employed in preference to hand mucking in headings where air shovels are not yet available.

An improvement on the bottom trap was the dumping of all bench muck directly into cars on the tunnel floor. This was accomplished by running wheelbarrows out on planks laid on stringers placed across the tunnel at bench level and supported by the plumb posts. This plan required extra timber work and still left the entire bench face to be mucked by hand.

A method found to be still better was the use of a jumbo or "high car" the full width of the tunnel, mounted on rails to move forward as the work advances as shown in the accompanying illustrations. Being arranged to take muck from two bench levels, one at wall plate height and another about 6 ft. lower, this plan leaves only the lower 7 or 8 ft. of the bench to be mucked by hand from the tunnel floor. This jumbo car has materially increased progress.

SAVING IN LABOR COST BY USE OF SHOVEL FOR MUCKING

Using Hand Mucking Method

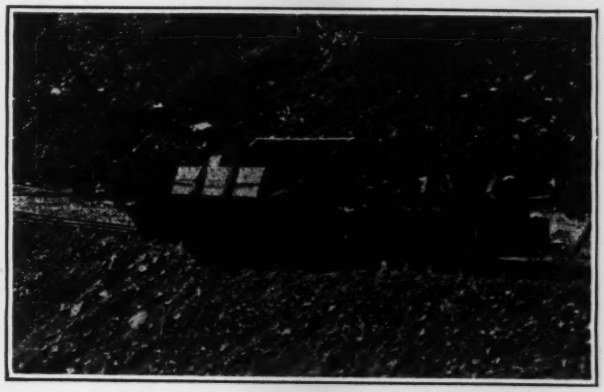
	Miners	Muckers	Shifters	Total for Shift
Top heading	7 at $5.50	9 at $4.50	1 at $6.50	$85.50
Tunnel floor	3 at 5.50	6 at 4.50	1 at 6.50	50.00
Totals	$55.00	$67.50	$13.00	$135.50

Using Air Shovel

	Miners	Muckers	Shifters	Shovel Operators	Total for Shift
Top heading	7 at $5.50	7 at $4.50	1 at $6.50	.....	$76.50
Tunnel floor	4 at 5.50	1 at 4.50	1 at 6.50	1 at $10	43.00
Totals	$60.50	$36.00	$13.00	$10	$119.50

The top of the jumbo is on a level with the wall plate bench to which it connects by means of trussed plank runways for the wheelbarrows. The bench level 6 ft. below is reached by a track projecting some 10 ft. in front of the jumbo and, when the outer end of this projecting apron is supported on the bench, it is used by ¾-cu.yd. cars. Wheelbarrows on the upper level dump into a bin, while the ¾-cu.yd. cars on the intermediate bench dump directly into 1½-cu.yd. cars on either of the two main tunnel tracks. The advantage of this arrangement is that muckers on all levels always have something to dump into and there is no delay while they wait for cars. Hand muckers on the floor of the tunnel shovel into the 1½-cu.yd. cars (42 in. above track) just as they do in the headings where muck from the entire face is shoveled by hand. The 1½-cu.yd. cars are taken out in 4-car trains and the muck from the bunkers is delivered into 6-cu.yd. cars on either track, these being hauled in 2-car trains.

A disadvantage of this jumbo which should be noted is that it increases the length of wheelbarrow haul from the top headings to the wheelbarrow dump point.



DUMPING 6½-CU.YD. CARS AT ROCK CREEK PORTAL
The detailed design of these cars was worked out especially for this job. The general idea of a low dump car, however, was suggested by the success of such cars on the Southern California Edison Co., Big Creek project.

The saving in labor cost resulting from the use of the shovel instead of hand labor for mucking is figured at $16 per shift or $1,440 per month per heading, derived from the figures in the accompanying table.

Hauling muck out of all headings is done by storage battery locomotives, of which ten are on the job. These locomotives weigh about 7 tons each, of which 3 tons' weight is the battery, which delivers 170 volts. They are well able to handle two of the 6-cu.yd. dump cars at 6½ miles per hour. There are four battery charging stations on the job, one at each portal, one at Rock Creek and one at the adit; one extra battery is provided for every two locomotives. The 290 amp.-hr. charge which the batteries take is sufficient for the normal operation. Recharging takes 4 to 6½ hours.

The Bonus System—To increase the speed of tunnel driving and to recompense the crews for the extra effort, all headings of the tunnel were put on a bonus basis beginning March 26. In headings mucked by hand the bonus crew consists of ten miners, fifteen muckers and two shift bosses. For headings where a power shovel is used, the bonus crew consists of eleven miners, eight muckers and two shift bosses.

The bonus is paid bi-monthly on the basis of 10 per cent of each man's pay for each average foot of progress in excess of the base rate of 11 ft. per day. In other words if the average daily progress in one heading for a bi-monthly period is 12.5 ft., each man's bonus will be 15 per cent of his pay.

The work on the Pit River No. 3 tunnel is in charge of the Pacific Gas & Electric Co.'s department of electrical construction and operation, with O. W. Peterson as engineer of general construction under vice-president P. M. Downing. G. M. Wehrle is general superintendent on the job.

Effect of Sulphur and Alternating Stress on Steel

Abstracts of A.S.T.M. Papers on Most Recent Results of Endurance Tests and on Data from Sulphur Investigations

Endurance Tests of Metals

MR. MOORE reported from tests made by the Engineering Division of the Air Service at McCook Field, Dayton, Ohio, that the following results had been obtained for magnesium-aluminum and magnesium-copper alloys, extruded and cast aluminum bronze, cast manganese bronze, carbon steel, vanadium steel, and stainless iron:

1. The magnesium-aluminum alloys have better endurance properties than the magnesium-copper alloy. The addition of 0.25 per cent of manganese to the magnesium-aluminum alloys raises the endurance limit about 15 to 25 per cent.
2. A comparison of extruded and cast aluminum bronze of similar chemical composition shows the extruded metal to have an endurance limit about 32 per cent higher than the cast metal. The endurance limit of cast manganese bronze is about 23 per cent less than that of cast aluminum bronze.
3. The endurance limit of steel and cast manganese bronze can be increased by gradually raising the stress during the endurance test.
4. The effect of notches on the endurance properties of metals is not in proportion to the concentration of stress caused by these notches. The effect is less than would be expected from the stress concentration. The cast aluminum bronze is much less affected than the extruded metal.
5. Fractures of test specimens from the repeated impact tests show that the test results are influenced not only by the material's resistance to shock but also by its resistance to fatigue. Complete impact-endurance curves should be obtained when comparing materials by this method as such curves for different metals often cross each other, so that comparisons made at a certain energy of blow are reversed at some heavier or lighter blow.

By a modification of the reverse torsion test for endurance which he has used for several years, D. J. McAdam, Jr., of the Naval Engineering Experiment Station at Annapolis, provided an accelerated fatigue test. The flywheel in this machine makes a swing which depends not only on the impressed rotational motion but also on the torsional yield of the test piece and the stress applied depends on the flywheel swing. With long specimens the fraction of the total twist due to the flywheel inertia can be made large, and in this case any increase in the yield of the specimen causes an increase in the stress applied to the specimen. Very accurate speed regulation is necessary to make the method consistent. Tests made in comparison with ordinary torsion endurance tests, and with rotating cantilever-beam tests, lead Mr. McAdam to the conclusion that the accelerated tests will give the same results in much shorter time than ordinary endurance tests. He believes that 6,000,000 alternations will give results equal to those of 100,000,000 in a straight endurance test. The accelerated method has been applied to various steels, to nickel, monel metal, copper, brasses and bronzes, and duralumin.

Using an alternating torsion machine of the spring type, Mr. McAdam also studied the endurance range when the stress was not completely reversed, but the minimum stress ranged from the negative value of the maximum stress up to zero. In previous tests made at the University of Illinois the endurance range for stress varied between zero and a maximum found to be 20 or 25 per cent smaller than the endurance range under full alternation. Mr. McAdam's tests, made on carbon steel, carbon-vanadium steel, nickel steel, and chrome-nickel steel, indicated that the torsion endurance range does not vary more than about 5 per cent with change in the ratio of maximum to minimum stress.

TABLE SHOWING STRENGTHENING EFFECT OF UNDERSTRESSING

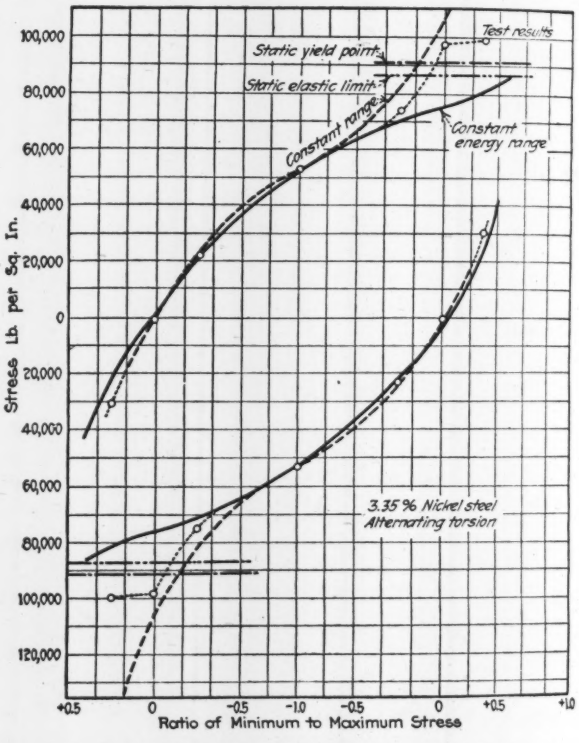
(Bureau of Mines Tests, Gillett and Mack)

Steel No. 2.—C, 0.41; Mo., 0.67. Normalized. 225 Brinell

Stress, Lb. per Sq.In.	Life, Number of Alternations	Remarks
60,000	276,000	Broke at middle of neck
57,000	26,900	Broke slightly below middle
55,000	1,137,000	Broke below middle
54,500	2,472,000	Not broken, stress raised
61,500	1,059,000	Not broken, stress raised
72,500	206,000	Broke at middle
Steel No. 24.—C, 0.40; Ni, 2.52; Cr4, 0.84; V, 0.20. Draw 1. 420 Brinell		
109,000	61,500	Broke at middle
106,000	273,000	Broke at middle
101,000	187,000	Broke slightly above middle
98,500	1,172,000	Not broken, stress raised
109,500	313,000	Broke slightly above middle
96,000	944,000	Not broken, stress raised
103,000	1,097,000	Not broken, stress raised
113,000	110,000	Broke at middle
106,000	1,164,000	Not broken, stress raised
109,500	1,476,000	Not broken stress raised
115,000	590,000	Broke at middle

This, of course, holds only within the elastic range of the material. It is to be emphasized that McAdam's results apply to torsional endurance, while the Illinois results apply to tension-compression endurance.

Extensive endurance tests were made by the Bureau of Mines during the past few years at its field office at Cornell University. The work has been discontinued in an uncompleted state, but what was learned so far as it has gone was reported by H. W. Gillett and E. L. Mack. A number of important deductions were made from the tests. Confirmatory proof was obtained of the strengthening effect of understressing, as illustrated by the attached table.



ENDURANCE RANGE DIAGRAM FOR 3.35 PER CENT NICKEL STEEL

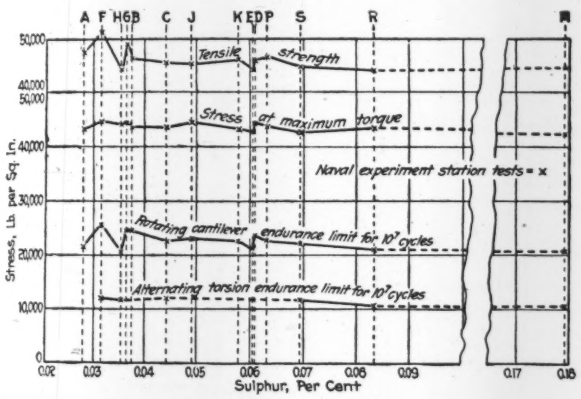
Following the McAdam method of plotting, with stress as ordinates on an arithmetic scale and number of cycles as abscissas on a logarithmic scale, the plots all showed curved portions merging into a horizontal; for the harder steels, the junction point was at a lower number of cycles than for the softer steels, and could be located satisfactorily by testing to 1,000,000 cycles. For the softer steels, the testing can be accelerated by running at a stress close to the probable endurance limit up to one or a few million

cycles and then continuing the test at higher stress. It was found that while there was apparently a very consistent relation between tensile strength and endurance limit, the relation is not linear throughout the whole length of the plot. Inclusions in steel ("dirty steel") tend to lower the endurance strength, probably by causing local stress concentrations. Internal stresses due to hardening also reduce the endurance strength. The maximum strength is obtained by drawing at a sufficiently high temperature or for a sufficient length of time to give fullest release of internal stress. The injurious effect of inclusions seems to be greater in hard steel than in soft steel. Endurance tests on non-ferrous metals have not led to very definite conclusions, but it appears that no definite endurance limit was detectable in tests up to 50,000,000 cycles. Below this limit no marked effect on endurance appeared to result from inhomogeneities such as lead in brass and oxygen in copper.

* * *

Effect of Sulphur in Steel

CONTINUING the study of the effect of sulphur on rivet steel which forms the first part of the program of the Joint Committee on Investigation of Phosphorus and Sulphur in Steel, formed some years ago, the committee last year made endurance tests of rivet steel with varying sulphur content up to 0.18 per cent, all of the sulphur being residual (not added in the ladle). The endurance tests were carried out at the Naval Engineering Experiment Station at Annapolis. Their results are well represented by the diagram shown herewith, which apply to rivet bars after annealing. Similar curves for quenched rivet bars


A F H G B C J K E D P S R
Tensile strength
Stress at maximum torque
Naval experiment station tests = x
Rotating cantilever endurance limit for 10⁷ cycles
Alternating torsion endurance limit for 10⁷ cycles
Stress, Lb. per Sq. In.
50,000
40,000
30,000
20,000
10,000
0
0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.17 0.18
Sulphur, Per Cent

RELATION OF ENDURANCE TO SULPHUR CONTENT OF ANNEALED RIVET STEEL

have the same general characteristics. The curves indicate no effect of sulphur on endurance, just as previous experiments indicated no effect of sulphur on tensile strength or other of the ordinary strength and ductility properties. The variations in the curves, particularly in the low-sulphur specimens, have previously been shown to be due to variations in manganese and carbon content.

An elaborate investigation of the microstructure of the various rivet steels tested was also carried out at Annapolis, at magnifications ranging from 100 to 4,000. Differences in the number of non-metallic inclusions were found, with a tendency toward the larger number of inclusions in the steel of higher sulphur content. The microstructures of the various steels also were found to differ, but no relationship between microstructure and mechanical properties was developed.

(Strength tests of plate steel of structural grade with varying sulphur content were separately reported by the committee, this being the first part of the investigation subsequent to the rivet tests, but this report is not available in detail at present. Diagrams exhibited at the meeting showed substantially the same appearance as the curves for the rivet steel, giving no indication of any sulphur influence.)

Harvard Bridge to Be Strengthened

UNDER a recent act of the Massachusetts legislature the Charles River bridge on the line of Massachusetts Ave., Boston, connecting Boston with Cambridge, commonly known as the Harvard bridge, is to be strengthened and provided with a new floor, instead of being replaced by a wholly new bridge. Rebuilding of the structure has been urged for several years past, and different projects for bridges of monumental type have been brought forward. The present decision to reinforce and re-floor the bridge is likely to postpone further consideration of such projects for some years.

The 1923 legislature directed the Metropolitan District Commission to investigate the construction of a new Charles River bridge at or near the location of the Harvard bridge, this new bridge to be without an island (a number of the bridge proposals for a monumental bridge contemplated a parked island at the middle of the length of the bridge). By request of the commission the investigation was entrusted to an advisory committee composed of Leonard Metcalf, representing the Boston Society of Civil Engineers; George F. Swain, representing Harvard College; Charles M. Spofford, representing Massachusetts Institute of Technology; and William D. Austin, representing the Boston Society of Architects.

Plans Considered—Various plans for replacing and for repairing the bridge were submitted to this committee. The favored plan was one for a wholly new bridge, designed by Robert B. Andrews. This contemplated a structure of seven masonry arches of 120 ft. span, of elliptical or basket-handle form, the arches to be faced with stone. The bridge itself was to cover only the middle portion of the crossing, and the end portions were to be formed of earth-fill projections from the two shores, where park development, balustrade terraces and the like were to be constructed. The entire crossing, with roadway 60 ft. wide between curbs, was estimated to cost $2,750,000. A somewhat similar design, but for a structure of nine arches, so arranged as to use alternate piers of the old bridge as parts of the new piers, was submitted by Bellows & Aldrich and R. W. Gray, architects; this plan was estimated to cost about the same as the preceding. On the other hand, repairing the steel arch bridge, providing stiffeners on all the floor beams, and in general rebuilding the floor for a permanent pavement in place of the present unsatisfactory wood strip pavement, involved a cost of only $350,000 to $475,000, according to the estimates of L. E. Moore, consulting engineer.

Construction of a new bridge according to the Andrews plan was recommended by the Metropolitan District Commission. The large cost of the structure, however, led the legislature to decide in favor of strengthening and repairing the existing bridge; the carrying charges under this plan will be only about $40,000 per year, while the carrying charges for the new bridge would be about $180,000. The 1924 legislature directed the Metropolitan District Commission to strengthen, repave and repair the bridge, substituting fixed spans for the draw span, and appropriated $600,000 for the work. As reconstructed under this project, the structure is estimated to have a life of twenty years. The alteration work is being designed by L. E. Moore.

Producing Artificial Ground Water at Frankfort, Germany

Highly Polluted River Water After Filtration Percolates Through Sandy Soil to Increase Ground Water Supply

By Dr. Scheelhaase
Director of Water-Works, Frankfort, Germany

In Collaboration with
Gordon M. Fair
Instructor in Sanitary Engineering, Harvard University, Cambridge, Mass.

ARTIFICIAL ground water has been produced in many sections of Europe since the end of the past century when, with the growth of cities and increased water consumption for manufacturing purposes, the natural ground water supplies in many localities became depleted. As surface waters had only been used for public water supplies in a few instances, it was natural to attempt increasing the yield of existing ground water supplies by augmenting the flow of phreatic water with surface water. At first this was done in a manner analogous to sewage farming by pumping river water on to agricultural areas (orchards) and permitting it to percolate through the soil to ground water level. To secure greater efficiency sandy areas were next prepared much in the manner of intermittent sand filters in sewage treatment and the water passed to the ground without traveling through the top soil. Later percolation ditches with sandy bottoms were dug, the sand being renewed from time to time to aid percolation. In practically all cases the surface water used for augmentation was relatively pure. At Berlin, for example, lake water, part of which is pumped to the city after slow sand filtration, is used in this way. In the Ruhr district the River Ruhr, which is kept in fair sanitary condition by the efforts of the Ruhr District Commission, serves as the source. At Gothenburg, Sweden, similarly a relatively slightly polluted surface water is utilized. The methods of producing artificial ground water developed at these cities are simple and present little information of general interest.

At Frankfort, Germany, the situation is somewhat different. There the River Main, while providing an abundant supply of surface water, is so badly polluted with sewage and industrial wastes from the manufacturing towns above Frankfort and carries such quantities of sediment and yellow coloring material that its use for ground-water augmentation presents in a very striking way the purification of water accomplished in nature's household.

Experimental Plant—In 1908 an experimental augmentation plant was constructed in the Frankfort municipal forest in which one of the city's ground-water supplies was located. At that time the yield of these works built by Lindley in 1885 had been reduced to about 1.1 m.g.d. after lowering the water table some 20 ft. It was believed that augmentation of the existing supply through the use of river water was preferable to seeking a new source. The experimental plant, situated about 1,600 ft. from the ground-water pumping station, was supplied with raw water from the city's river water mains used for lawn watering and street sprinkling. The plant was designed with a capacity of 130,000 g. p. d. and, with the exception of the three last war years, has been in continuous operation since its construction. Fig. 1, a longitudinal section through the augmentation works, shows the course of the water from the time it reaches the experimental plant to the time it is lifted from the ground to be pumped to the city. On account of its high turbidity and organic load, the raw Main River water is first passed through a scrubber whose operation is similar to that of a mechanical filter with coarse filtering medium. The effluent from the scrubber flows onto open slow sand filters, from which it passes to the exfiltration gallery situated 10 ft. below the surface of the ground. The gallery consists of two 80-ft. branches of tile pipe used alternately and laid with open joints through

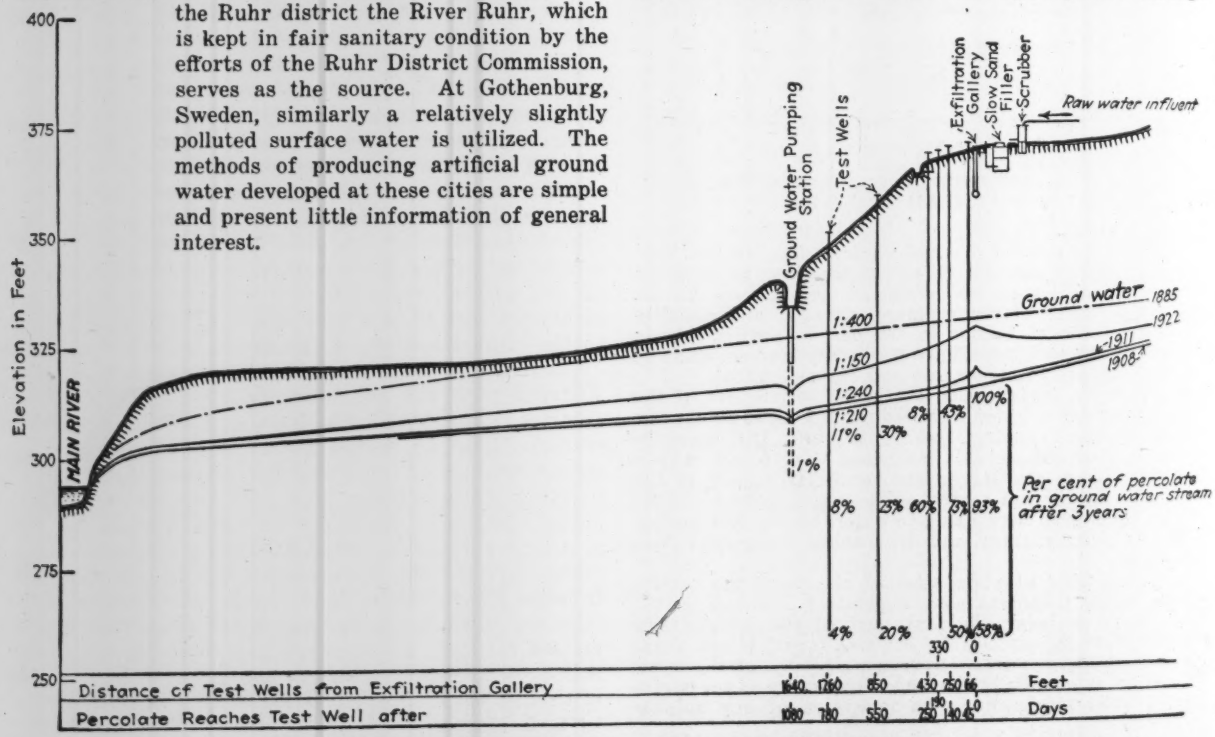


FIG. 1—LONGITUDINAL SECTION THROUGH EXPERIMENTAL PLANT

which the water flows into the ground. Without completely filling the pores of the gravel and sand layers, the exfiltrate percolates through 43 ft. of sandy soil before it reaches the ground-water level. The fact that the water does not unite hydraulically with the ground water until it has made its way through so great a depth of sand and gravel mixing with the ground air in its passage explains the extensive chemical and biological changes that take place in the percolate. These changes require two things, air and time: Air, to supply the oxygen necessary for the oxidation of the organic impurities; and time, to permit this somewhat slow process to be completed. If the percolating water were to fill the pores of the ground completely and thus establish an hydraulic union with the ground water, the ground air would be displaced, the velocity of flow would increase, and the small amount of oxygen in the water would be insufficient to bring about mineralization of the organic impurities. In the Frankfort experiments the time elapsing before the exfiltrate reaches the ground water level is 14 days.

After uniting with the natural ground water, the percolate takes its path with the former to the intake works. Test wells equipped with small compressed air lifts are provided at varying intervals along the way and with their aid samples of water can be obtained from various depths. The natural difference in the alkalinity of the ground water and river water was utilized to trace the flow of the new ground water stream. The exfiltrate contains from 180 to 200 p.p.m. of alkalinity, whereas the ground water contains but 20. Fig. 3 shows the progressive increase in the alkalinity of the ground water after augmentation was begun. The per cent of exfiltrate present in the ground water at various depths and distances from the infiltration works after three years of operation is shown in Fig. 1. The velocity of flow was found to be 1.6 ft. per day so that the first traces of exfiltrate arrived at the pumping station only after three years. A rise of the ground-water level and with it an increase in the yield of the works was noticeable, however, after a few weeks. The slope of the ground water prior to augmentation was 1 in 240; after three weeks of operation it had become 1 in 210. Within this short interval of time, therefore, the capacity of the works had been favorably affected. Today the plant yields 2.1 m.g.d., a gain of 1 m.g.d. over 1908. This increase, however, is only due in part to augmentation proper as the draft on these works was decreased for some time and the natural ground water level thus permitted to rise.

Change in Water Quality—The change in the organic impurities of the water as indicated by the oxygen consumed test is shown in Fig. 2 for the first three years of operation and for the year 1921. From this it would appear that filtration decreases the organic load of the water but slightly. During percolation, however, even only as far as the first test well (Well No. 66, situated 66 ft. distant from the exfiltration gallery) a marked reduction seems to occur. The results of the oxygen consumed test are substantiated by the changes in color, odor, and taste which even at this first well no longer retain the characteristics of surface water. At the same time the nitrates have increased materially. The bacterial count at Well 66, as might be expected, is practically zero with B. coli always absent. The temperature of the surface water produces in the ground water a rise in temperature of 5 deg. F. during the summer and a fall of 3 deg. F. during the winter. On the way from Well No. 66 to the intake works further improvement in the quality of the percolate takes place. The temperature at Well No. 250 has become stabilized at 50 deg. F. and flat tastes or odors are absent in samples drawn from Well No. 330. Color reduction takes place more slowly and at Well No. 410 the water still appears faintly yellow when compared with the natural ground water. On the whole, the results seem to indicate that the extremely heavily polluted Main water becomes a good ground water by the time it reaches Well No. 330, 190 days after exfiltration.

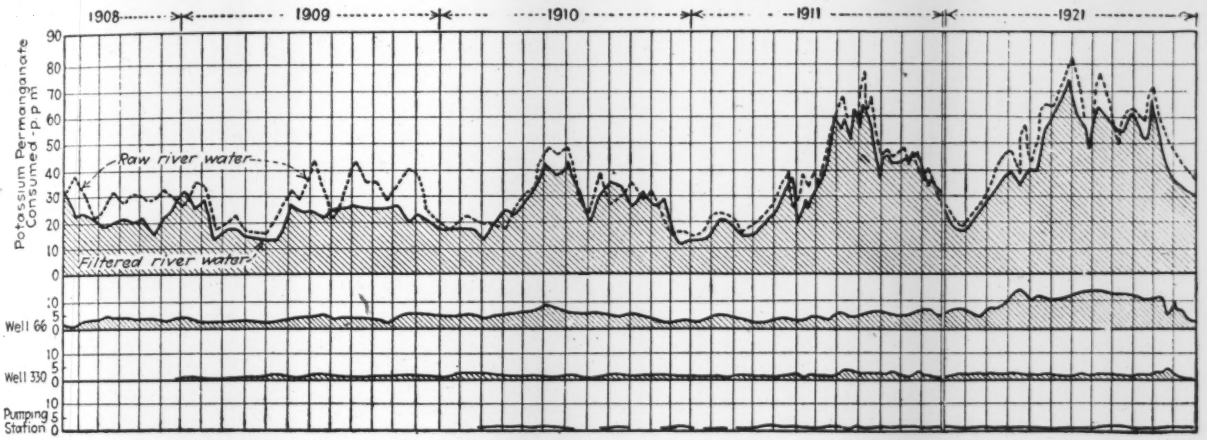


FIG. 2—OXIDATION OF ORGANIC MATTER DURING PERCOLATION

The "oxygen consumed" test is here used to measure the progressive mineralization of the organic material as the water passes through the ground.

Operating Experience—No difficulties of operation were experienced and the two branches of the exfiltration gallery have not clogged during twelve years of operation. The treatment of the river water by means of scrubbers and slow sand filters has proved to be economical and satisfactory. Preliminary treatment of the river water was necessitated by the fact that the population served with the ground water from these

particular works had to be persuaded that a simple mixing of Main River water with the ground water was not being attempted, but that the Main water was actually converted into ground water. The use of highly polluted river water made a checking of the results by other authorities advisable. This was done both by the Hygienic Institute of Frankfort and the Federal Institute of Water Hygiene in Berlin. The latter gave the opinion that the percolate cannot be distinguished from the best ground water at a distance of 500 ft. from the exfiltration gallery either in temperature, odor, taste, color, or chemical characteristics.

The originators of the experiment have since come to the conclusion that the required preliminary treatment of the water can be accomplished more easily in a different manner. Artificial filtration, resulting in the retention of bacteria and other suspended polluting matters in the river water, can be replaced with equally good results by clarifying the river water in a pond and permitting it to percolate slowly into the sandy soil through ditches. However, only very small use may then be made of the percolating area, for in this way only can percolation of the water into the underground be accomplished and establishing of hydraulic union between the exfiltrate and the ground water be avoided. Complete oxidation of the organic materials, too, can only take place in the pore spaces above the ground water. This is the case in the Frankfort experiments where the exfiltrate percolates to the natural ground water in 14 days, a period of time permitting thorough oxidation by the ground air.

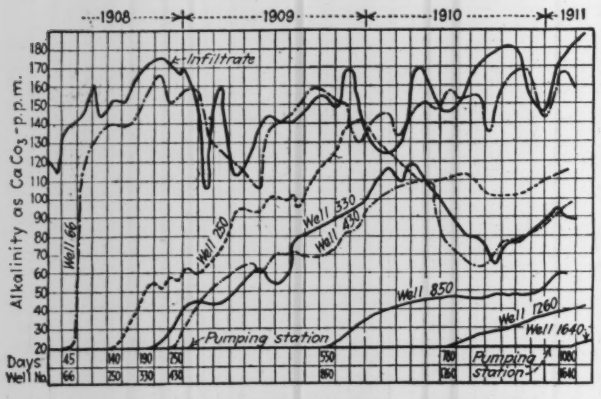


FIG. 3—INCREASE IN GROUND WATER ALKALINITY AS RESULT OF AUGMENTATION

The increase in alkalinity above the normal alkalinity of the ground water is a measure of the velocity of flow of the ground water and the amount of percolate found at different points in the catchment area.

Operating Plant—The good results obtained with the experimental plant led to the construction of an operating plant on somewhat the same principles. Preliminary treatment, however, was changed in the light of experience gained and the scrubber replaced by a clarifying pond. Instead of building an exfiltration gallery placed 10 ft. below the ground, shallow ditches were constructed through which the water percolates into the sand. Because of the need for water the operating plant was completed despite the economic depression prevailing in Germany and put into operation at the end of 1921, delivering between 0.5 and 1.0 m.g.d. of exfiltrate. Results since obtained have fully justified expectations. The pumping station was extended and operates with a daily increased yield of 1.3 to 2.1 m.g.d. The ground-water level has already risen 6.5 ft. and augmentation which is continued throughout the year permits a yield of double the quantity during the summer, the time of greatest consumption. The water taken from test wells near the point of exfiltration shows the same good results as were obtained from the experimental plant.

To Classify Reclamation Project Lands

RECLAMATION project lands are to be classified as to soil characteristics and other factors, and the irrigable area against which irrigation charges may be assessed is to be determined in a new survey, according to an announcement just issued by the Bureau of Reclamation. The survey will be made in accordance with the recommendations of the Committee of Special Advisers which reported two months ago.

Land is to be classified in four classes, of graded productive capacity, and no land is to be excluded unless it is clearly incapable of successful irrigation. A census of the financial condition of the water users is to be taken, "with the view of proposing a plan for refunding the indebtedness of water users other than amounts owing to the United States, at lower interest rates." The total irrigable area of each project is to be determined, as the basis for the allocation of government charges, and areas which should be excluded from further consideration are to be determined by this survey. Present and future drainage needs are also to be investigated and the ability of the reclamation farmers to pay the cost of this drainage is to be appraised. Where parts of a reclamation project are found to be particularly difficult to make productive, they are to be subjected to special study to determine whether it would be feasible for the government to assist settlers in preparing such land for use.

Excess holdings of land are to be listed, and the legality of such holdings under the existing reclamation law is to be studied. Vacant irrigable land is to be reported. The possibility and utility of giving agricultural advice to the farmers, means of improving economic conditions on the projects in general and other elements of project administration included in the recommendations of the Special Advisers are to be covered by the survey.

Field studies of five proposed new projects are also to be made this summer. These are the Owyhee project and the Yale project, Oregon; the Salt Lake Basin project, Utah; the Spanish Springs project, Nevada; and the Kittitas project, Washington. The field data are in each case to be reviewed by a committee made up of one member of the Bureau, a farm management authority, and a financial authority, which committee is to fix the development cost and the probable yield in order to determine the conditions which would render the project feasible or non-feasible.

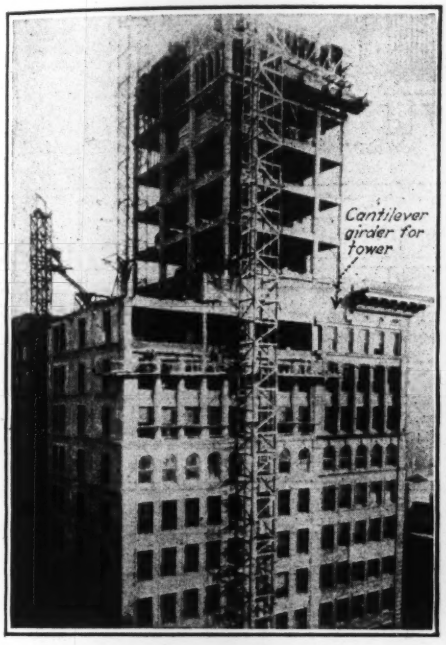
Highway Traffic 1.2 Per Cent Horse-Drawn

Traffic counts on California state highways recorded 2.3 per cent of the traffic as horse-drawn in 1920, and 1.2 per cent horse-drawn in 1922. In the same period the total traffic increased 47.4 per cent. No traffic census has been made since 1922 but one will be made this year.

Highest Concrete Building; 274 Ft. Above Sidewalk

Office Building at Dayton, Ohio, Said to Hold Record—Heavy Cantilever and Girder Framing for Tower Carried on New Reinforced-Concrete Section and Old Steel-Frame Section

THE HIGHEST reinforced-concrete building yet constructed is believed to be the new United Brethren Building at Dayton, Ohio, a combined store and office structure, having a total height of 274 ft. 3 in. from sidewalk to peak of tower roof. A special feature in its structural design is that the tower is carried partly by the new structure and partly by the older portion of the building, which is of steel-frame construction. When the architects planned the addition, they found that the cost of concrete design would be about 25 per cent less than that of a steel design. In Fig. 1, the older portion of the building includes the five windows from the right. It will be seen that the cantilever end of the concrete girder at the top of the new main building extends over the older part of the building (where the cornice has been cut away) and carries two columns of the tower.



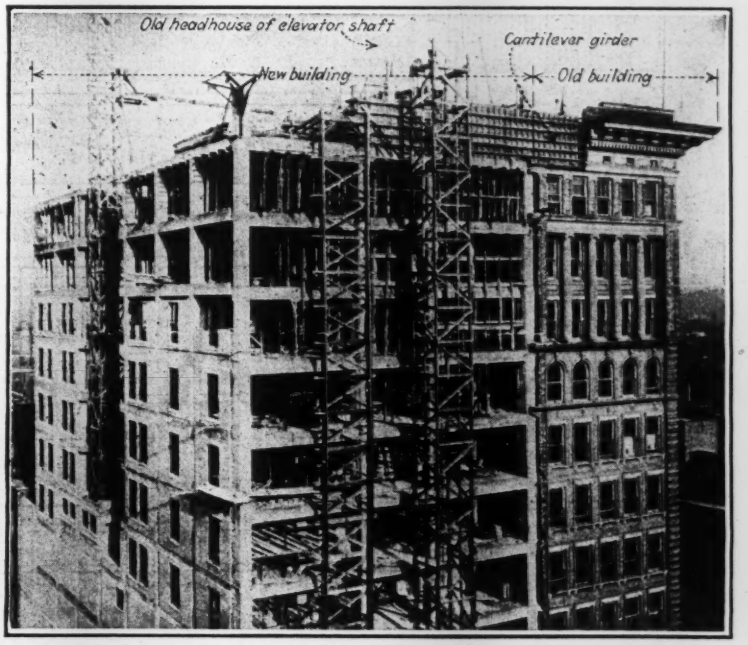


FIG. 1—UNITED BRETHREN BUILDING AT DAYTON, OHIO

New concrete portion and tower. Old steel-frame portion, first five windows at right of building. Note cantilever girder at the roof level. Right view: erection of new building. Left view: tower framing erected.

A steel-frame structure built in 1904 at the northeast corner of Main and Fourth Sts. constitutes the original part of the building, and is 50 ft. 5 in. x 128 ft. 8 in. in plan, with a height of fourteen stories and basement. It has spread foundations of concrete footings reinforced by a grillage of steel I-beams. The concrete addition on the north side is of the same height, 59 ft. x 104 ft. 5½ in. in plan, giving a new street front of 109 ft. 5 in. At the middle of the combined structure is a six-story tower, 50x51 ft. 3 in., beginning at the fourteenth floor and surmounted by a pyramidal roof. This tower is carried by six of the old steel columns and four of the new concrete columns, but the tower columns are not all symmetrical with those of the main part of the building, as will be seen from the part plan of the fifteenth floor and the sections in Fig. 2.

Footings and Foundation Cantilevers—In order to carry out this new design it became necessary to wreck the north wall of the old building and to reinforce the steel columns and their footings in this wall for the additional loads imposed by the new building extension and by the tower. It was intended originally to support the north side of the old building by cribbing the columns while the old footings were cut away and replaced by larger footings. But as this procedure would disturb the soil and might cause settlement, it was decided that a better and more economical method would be to leave the old footings and enlarge them by side strips to give the required area of base.

This method of enlarging and strengthening the footings is shown clearly in Fig. 3. As it was necessary to cantilever the new strips across the old footings, some trimming and cutting of the old concrete had to be done to provide for placing two additional grillage beams and additional reinforcing rods. To take care of the upward vertical reaction from the new footing strips, wide column reinforcements were designed, extending about 6 ft. above the footings and transmitting the stress into the steel columns and their reinforced-concrete jacketing above this point. This arrangement was found to be a successful solution of the problem of cantilever action. The soil, consisting of about 60 per cent gravel and 40 per cent coarse sand, is capable of sustaining a safe load of 6,000 lb. per square foot. The maximum column loads are about 1,000,000 lb. at basement floor.

Reinforcement of the old steel columns to provide for additional loading is effected by casing them in concrete reinforced with spirals and vertical rods. This concrete jacketing also supports the concrete girders in the plane of the old north wall, which girders in turn enclose the original steel girders or beams. The steel columns which were cased with tile for fire protection were found in good condition. Cantilever girders of reinforced concrete support the wall columns 5 in. thick and 12 in. deep under the 2½-in. floor slab. All interior floor girders are of the same depth as the joists, in order to provide for a flat ceiling of plaster on ribbed metal lath. It will be noticed that the sides of the joists are vertical, with ½-in. fillets at their connections with the floor slab. For this construction collapsible wood forms were used and are claimed to have effected a saving of 20 per cent in concrete as compared with the type of form which requires inclined

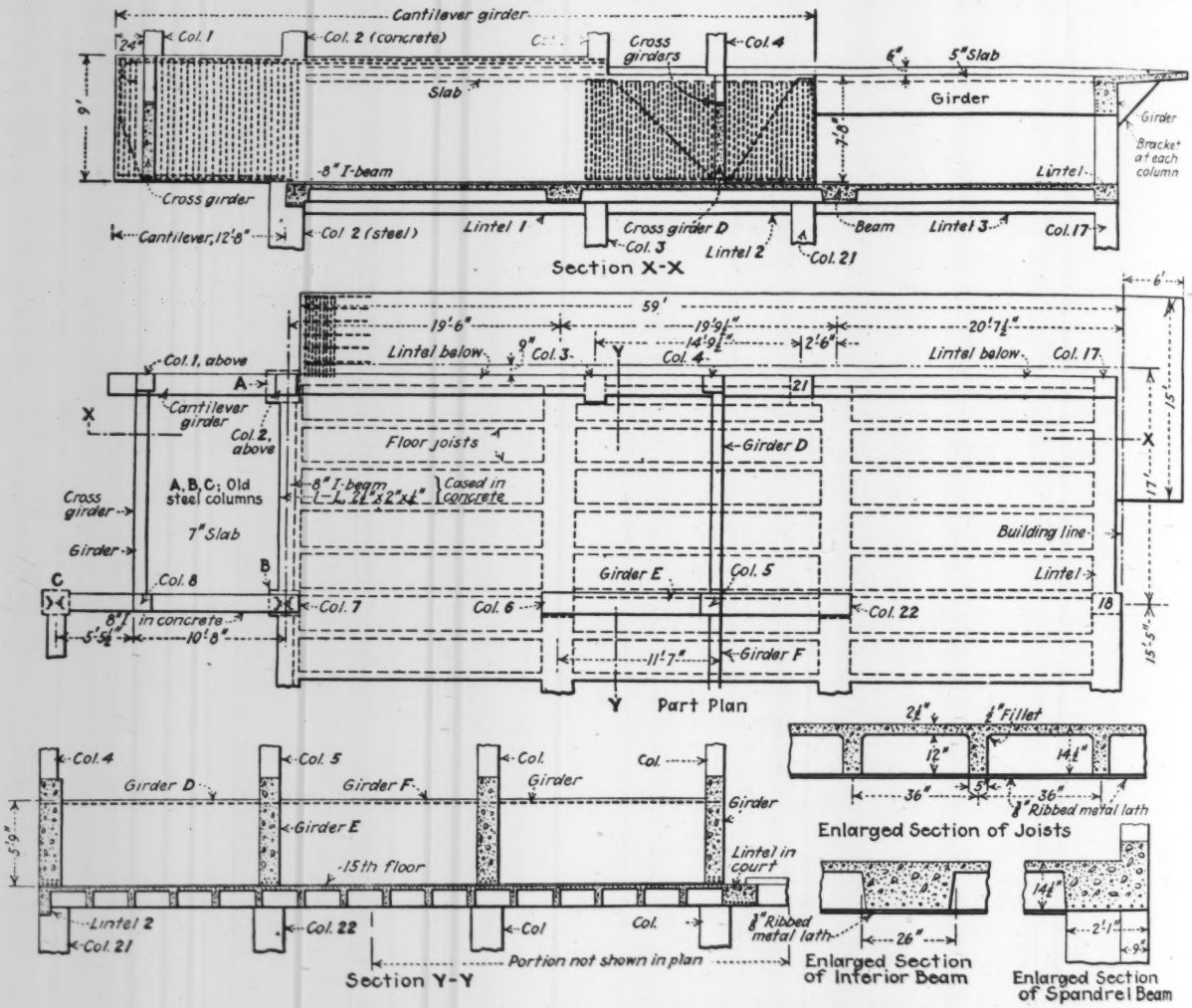


FIG. 2—PART PLAN OF 15th FLOOR, WITH GIRDER FRAMING FOR TOWER

in the new north wall, where footings could not be extended beyond the property line. As shown in Fig. 4, the ends of these cantilevers are connected by a longitudinal girder under the wall; at the east end elevator pits are formed between these cantilevers. Where concrete beams had to be connected to the old steel columns, special hangers were employed, somewhat as in the Masonic Temple building at Madison, Wis., described in *Engineering News-Record*, May 1, 1924, page 760.

Floors—Floor construction of the beam and joist type was adopted, but with the wide spacing of 3 ft. c. to c. of joists instead of the more usual 2-ft. spacing. The floors are designed for a live-load of 50 lb. per square foot, with the exception of 100 lb. for the first floor.

Typical details are shown in Fig. 2. The joists are faces for the joists. Each set of forms was used several times.

Tower and Cantilever Girders—A heavy concrete girder 54 ft. long and 9 ft. deep at the 15th floor level (or roof level of the main building) supports the front eccentrically spaced columns of the tower in the street front of the building, as shown in Figs. 1 and 2. This girder has a cantilever length of 12 ft. 8 in. beyond the new building, so as to limit the load on the steel frame in the front of the old building. The other three sides of the tower are carried by girders 9 ft. deep, supported by the concrete columns on one side and the steel columns (with concrete reinforcement) on the other side. In construction these 9-ft. girders were a difficult problem. The floors below had been poured at intervals of one week, so that to carry the heavy load

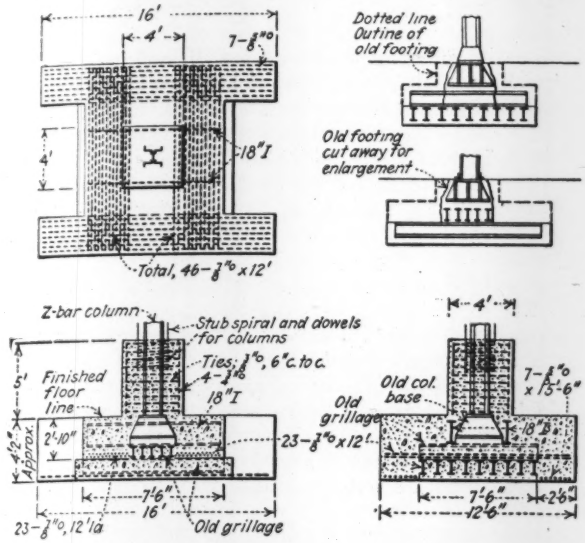


FIG. 3—REINFORCING OLD FOOTINGS

of the concrete in the 15th floor girders, which was approximately 2,000 lb., per lineal foot, it became necessary to erect special shoring and cribbing in the five stories above the 10th floor.

In the pyramid roof of the tower, Fig. 5, the framing consists of rectangular rings of beams and a 3-in. slab, the beams and slab being poured together. This roof was another difficulty in the construction, owing to its steep pitch. Copper roofing with upstanding ribs is used for the tower, but the flat roof of the main building is covered with composition roofing.

Flooring is of cement, marble and wood in different parts of the building. Metal sash is used, except for the windows in the street front. The exterior facing is of stone. Interior plaster finish is applied directly to the concrete surfaces.

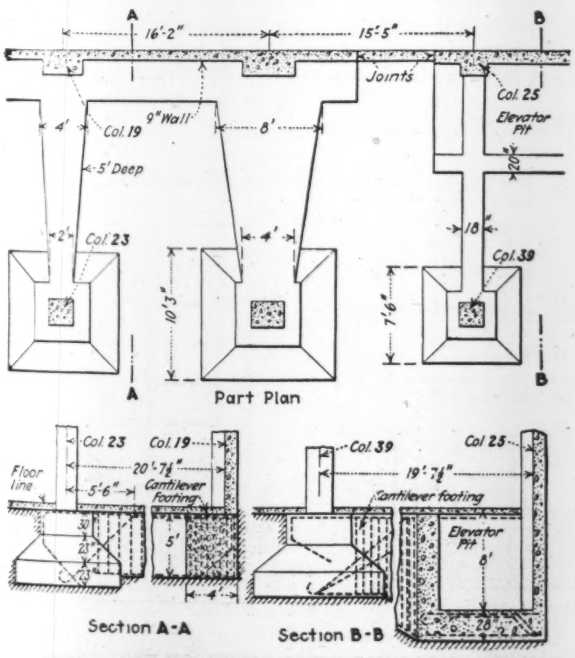
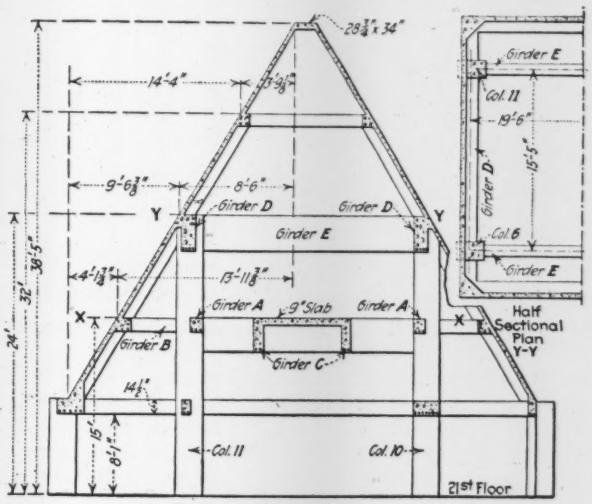


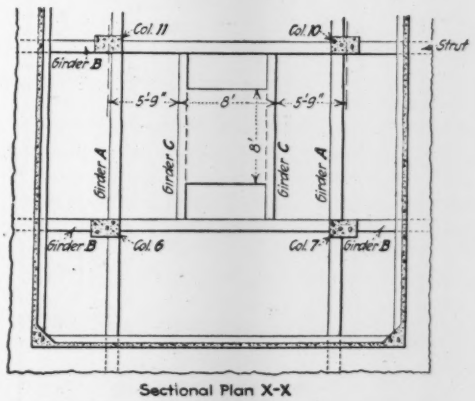
FIG. 4—CANTILEVER FOUNDATION GIRDERS

Piping and Elevator Equipment—All piping and wiring is carried in vertical shafts and horizontal conduits. Four elevators serve the store portion of the building and three high-speed elevators serve the office portion, two of the latter extending into the tower. The elevator shaft is in the older part of the building and all columns and beams around this shaft were reinforced and cased with concrete.

Construction Methods—The construction plant was located in the basement, and owing to the importance of this street corner there was no space available for



Section of Tower Framing



Sectional Plan X-X

FIG. 5—FRAMING OF TOWER ROOF

the storage of material. The casing of the columns and beams at the elevator shaft was carried on from the basement to the 16th floor without stopping the operation of the elevators, although all work was done during the day. Gravel concrete of 1:2:4 mix was spouted to hoppers on the floors and thence wheeled to the forms. A concreting tower, material hoist and slide hoist are shown in Fig. 1.

This reinforced-concrete building was designed by the F. J. Hughes Co., architects, Dayton, Ohio. The structural design was revised by the B. & A. Co., engineers and contractors, Chicago, which firm also had the contract for the concrete construction and the brick and stone work. S. J. Branson, of this firm, was the designing engineer, and G. S. Bergendahl was in charge of both the design and the construction. All construction work was handled by the subcontract system under

the direct supervision of the architects. Some parts were done by the owners, such as carpentry, bricklaying cement work and a certain amount of the alterations. The owners also purchased directly certain materials, such as ornamental iron. On the entire building there were six branches of work let by subcontract, the balance being handled entirely by the owners. It is stated by the architects that in this way there was a saving of more than $300,000 as compared with the lowest general bids received. Foundation work was commenced in February, 1923, and the seven floors for the store portion of the building were ready for occupancy by Feb. 1, 1924.

Omaha Aerial Mail Hangar Wrecked by Gale

End Wall Crushed In and Roof Trusses Twisted Out of Position—Roof Framework Had No Lateral Bracing

By Rodman M. Brown
Engineer with A. C. Arend, Consulting Engineer, Omaha

A VIOLENT gale on June 22 crushed in the end of a large steel-framed airplane hangar at Omaha, damaging eleven airplanes that were in the shed, awaiting the start of transcontinental air-mail service scheduled for July 1. Two days later, on June 24, a second storm completed the wrecking of the structure. The circumstances of the wreck and the design of the structure are of considerable interest.

The structure, after its collapse, is shown in Figs. 2 and 3 herewith, the former showing the conditions after the first storm, the second those after the June 24 storm. The first storm, which came from the west, crushed in the west end of the hangar, in which were located sliding doors arranged to give an unobstructed opening 117½ ft. wide by 20 ft. high; the doors were closed at the time. The two westerly trusses were bent inward, after failure of the struts and sway bracing between trusses, and sagged almost to the floor. There was no lower-chord lateral bracing and no bracing in the plane of the roof except that furnished by the roof planking. The second storm, coming from the northwest, tore off the roof of the shed, blew out the wood framing of the east wall, and completed the wrecking of the steel frame of the shed roof. The doors had been removed after the first storm, so that although the second one was considerably less violent it probably had a greater effect on the building.

The hangar was built in 1920, to plans drawn by Charles W. Steinbaugh, of Omaha, architect. John E. Wakefield Co., of Omaha, was the contractor, and the Omaha Steel Works fabricated and erected the steel frame. The hangar cost about $32,000.

The U. S. post office department, at the time it was studying the most feasible transcontinental route for the aerial mail, received an offer from the Omaha Chamber of Commerce to provide a suitable landing field and hangar if Omaha were selected as a landing point. The site finally chosen under this offer was the south portion of the Ak-Sar-Ben field, some 60 acres of flat level land a short distance west of the city limits of Omaha. The hangar was erected at the northwest corner of 62nd and Center Sts. Funds for construction were collected through subscriptions from individual members of the Chamber of Commerce. The architect's design was approved by the federal authorities; a contract was let late in 1919, and early in 1920 the building was turned over to the post office department.

Construction of Hangar—The drawings in Fig. 1, prepared from blueprints furnished through the courtesy of Mr. Steinbaugh, architect of the building, show the main features of the structure. The shed was 125 ft. wide by 112 ft. long, and had a steel frame consisting of seven transverse trusses spanning 125 ft. and spaced 16 ft. apart, framed into H-columns of rolled section. One truss was in the plane of the west wall, as the doors were located in this end, while the east wall contained no steel but was of frame construction like the sides. The steel framework was braced by four panels of rod sways in each side wall, and four panels of intermediate sway bracing between trusses in each of two vertical planes longitudinal to the building. This sway bracing consisted of struts in the plane of the bottom chord and crossed diagonals, but no struts

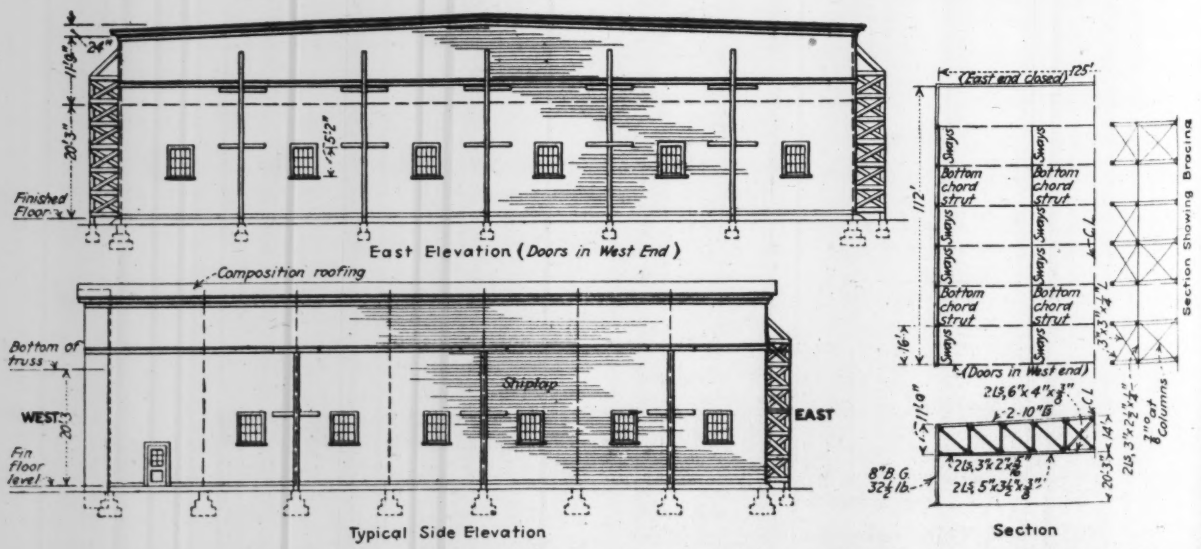


FIG. 1—CONSTRUCTION OF HANGAR—UPPER DOOR GUIDES AT BOTTOM-CHORD LEVEL OF EAST TRUSS

in the plane of the top chord. Between the braced panels the bottom-chord struts continued as connections of the trusses. The trusses lacked all lateral bracing, both in the roof plane and in the plane of the bottom chord.

The roof consisted of 2x12-in. joists about 24 in. on centers, spiked to 2x6-in. plates bolted to the trusses, and ⅞-in. shiplap sheathing covered with prepared roofing. The side and rear walls and that part of the front or west wall not occupied by the doors consisted of wood framing and sheathing, comprising 2x6-in. studs about 24 in. on centers (doubled either side of the windows), spiked to 2x6-in. plates and caps, and covered with ⅞-in. shiplap lumber. The two side walls and the rear or east wall were each braced by some timber buttress-like vertical frames or trusses, as shown in Fig. 1. These consisted of three 2x10-in. sticks in each chord, with two 2x8-in. planks for diagonal and horizontal members, bolted together; the trusses were 5 ft. deep c. to c. of chords. At the base, these trusses were bolted to U-shaped straps 2¼x⅝ in., set into 12x12-in. concrete piers. Each column of the building was anchored to its concrete pier by two 1-in. round anchor rods hacked for bond, set about 16 in. into the concrete pier.

In the west wall of the hangar were eight doors, 14 ft. 9 in. by 20 ft. high, sliding horizontally on tracks at the bottom and held by door guides at the top, so arranged that four doors would slide into a pocket at either end of the opening, to leave a clear unobstructed opening 117½ ft. wide by 20 ft. high. The tracks (at floor level) were supported on a concrete sill. The door guides at the top were just below the level of the bottom chord of the truss, and were carried by this truss. Thus the wind pressure on the doors divided equally between the concrete sill at the bottom and the door guides at the top, the latter transmitting the wind thrust to the bottom chord of the end truss.

First Storm—About 6 p.m. of Sunday, June 22, 1924, a violent gale from the west broke over the city, doing great damage to wires, trees, signs and sheds. The Weather Bureau office at Omaha reported a wind velocity of something over 52 miles per hour, but as this office is located in the heart of the city, six miles northeast of the field, on a slope rising to the west, and thus is protected both by the topography and by city buildings from westerly storms, it is certain that the wind reached a much higher velocity in the flat outlying territory surrounding the air-mail field.

When the storm broke, the eight doors of the hangar were closed and locked. The pressure of the wind was sufficient to cause the struts between the end truss and the next truss to bend almost double, forcing the middle part of both trusses inward, or toward the east. With the failure of the cross-bracing these trusses sagged almost to the floor. At the time there were eleven air-planes in the hangar, all thoroughly tuned up and ready for the installation of the night-flying schedule which was to go into effect a week or so later.

FIG. 2—QMAHA AIR-MAIL HANGAR AFTER FIRST STORM

After the storm the doors were removed and the whole force of the air-mail service in Omaha set to work to repair the damage to the planes. The planes were spiked down outside the hangar, and by the end of the following day the fleet was almost entirely repaired. However, about 3 a.m. the next morning, Tuesday, June 24, a second gale of almost tornado violence and action came out of the northwest and did much further damage to the planes as well as to the hangar. All of the planes were torn from their moorings and thrown considerable distances, and one was carried completely over the hangar and wrecked in trees to the east.

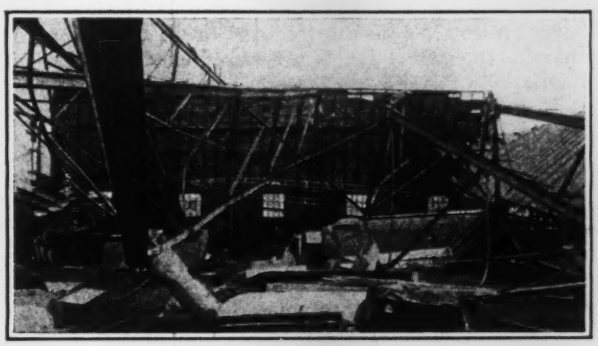


FIG. 3—SECOND STORM UNROOFED THE HANGAR

Effect of Second Storm—This second storm tore off the roof sheathing of the hangar, laid the east wall flat, and caused the complete collapse of the structure, as shown by the view Fig. 3.

When the east wall went over, the concrete buttress piers next the wall broke off at about the top of the

upper footing and pulled out of the ground, but remained bolted to the ends of the buttresses. The hacked anchor rods of the columns supporting the west truss of the building (at the door end) were pulled partly out of the concrete piers. Large sections of the roof were carried several hundred feet and deposited intact in surrounding fields. The center of the west wall, as it now lies, is about 30 ft. east of its original position, and all of the trusses have been pushed east at their middle point to a greater or less extent. There were no indications of deterioration in any part of the steelwork; the red-lead paint was still bright and clean.

Following the second storm, the air-mail force again went to work, under the direct supervision of Carl F. Egge, general superintendent of air-mail service, and of D. B. Colyer, superintendent of the central division, to repair the planes. Within twenty-four hours one plane was again in shape for flying, and a second nearly so, and the start of the night flying saw nine of the wrecked planes ready for work. Only one plane was a total loss.

Conclusion—It is the writer's opinion that, had no reliance been placed upon the wood roof structure to resist lateral pressure, and had the steelwork been properly braced, the structure would have withstood the first storm successfully. Since the west end of the building was open when the second storm struck it, the wind was able to do much greater damage than would otherwise have been the case. However, in a properly braced structure, even if the second storm had taken off the roof the steel frame would have remained standing. The structure would have been suitably braced for this purpose if top struts as well as bottom struts had been used in the sway bracing, if all of these struts had been designed for a heavier wind pressure and their length ratio had been held at or below 150, and if suitable and sufficient horizontal systems of lateral bracing had been introduced in the bottom-chord plane in the same panels as were fitted with sway bracing.

Steel Corrosion Tests by Ultra-Violet Rays

In recent tests made in the U. S. Bureau of Standards, the effect of ultra-violet rays upon polished metal surfaces was observed by allowing the rays to play upon a small area of the surface, the remainder of the surface being shielded by a thin metal sheet. Specimens of Armco iron, medium-carbon steel, "stainless" steel and high-nickel steel were exposed for 18 hr. to the ultra-violet rays, the result being a pronounced change in the exposed area. When the specimen is cooled and the moisture of the breath is allowed to condense on the surface, the exposed area becomes visible at once, the drops of condensation being larger than on the unexposed parts and the surface looking as though a thin film of oil had been spread over it so that it is not wetted so easily as the rest of the surface. In the medium-carbon steel, very noticeable corrosion of the exposed spot occurred after four condensations of moisture, while the remainder of the surface was hardly attacked. Chromium and nickel steels did not show any corrosion, although the same difference between exposed and unexposed areas was noticed. The nature of the change produced by the ultra-violet light is not yet known.

Semi-Circular Weirs Calibrated at Purdue University

Interesting Results from Tests of Different Sized Openings—Further Experiments To Verify Results

By F. W. Greve

Assistant Professor of Hydraulic Engineering, Purdue University

EXTENSIVE experiments dealing with curved weirs, or notches, cut in a vertical wall have been in progress for some time at the hydraulic laboratory of Purdue University. As part of the project, tests were made in the early months of the present year on semi-circular openings to determine the relation between the head and the quantity of water discharged.

The extensive literature on rectangular and triangular notches, together with the data collected on parabolic openings in the hydraulic laboratory, indicate very clearly that the logarithm of the discharge through any notch varies in constant ratio with the logarithm of the head. The equation representing this ratio is,

$$q = m(h)^n \qquad (1)$$

where q is the discharge, usually in second-feet; m is a coefficient varying with the shape and size of the weir; h is the head in feet and n is a constant exponent for any given type of opening.

Description of Apparatus—The notches were semi-circular in shape, edges beveled, with diameters of 6⅜, 12, 18, 24 and 29⅛ inches, respectively. Each notch was cut in a mild steel plate, 48 in. long, 22 in. high and ⅛ in. thick, which was bolted to the upstream face of a wooden bulkhead set across the discharge end of a long channel of approach. Details of the weirs and their settings are shown in Fig. 1. Leakage around the bulkhead was prevented by rubber gaskets. The water was supplied by a 6-in. motor-driven centrifugal pump, entering the channel through a vertical 6-in. pipe, 38 ft. upstream from the weirs. The supply pipe discharged below the water surface in order to minimize the disturbance created thereby. Baffle boards were also installed in the channel to eliminate eddy currents and thus provide a smooth water surface at the hook gage and the weir.

The channel of approach varied from 8 to 5 ft. in width and was 6 ft. deep. The depth of water below the centers of the notches was 4 ft. 6 in., the center being the point about which the outline of the notch was described. The head was measured with a hook gage reading directly to 1/1000th of a foot. This gage was permanently located 5 ft. 3½ in. upstream from the weirs and 13 in. from the side wall of the channel. The head represented the depth of water above the bottom of the notch, which point was designated as the crest. The outlet end of the channel was equipped with a movable apron so designed that the discharge could be diverted into either a calibrated weighing tank of 20-tons capacity or into the reservoir.

Method—The weir plate was levelled and drawn into a vertical position by means of ⅜-in. bolts. The hook gage, attached to an immovable beam placed across the top of the channel walls, was made vertical with the aid of a wye level. The reading on this gage for zero head was determined in the following manner. A scale

VALUES OF m AND n IN EQUATION (1)

Diam., In.	6	12	18	24	29
m	1.87	2.93	3.76	4.44	5.20
n	1.86	1.87	1.88	1.88	1.89
	If $n = 1.88$, a constant				
m	1.93	2.97	3.76	4.44	5.18

was held at the weir crest in an upright position. Several readings were made on the scale, after which it was moved to the point of the hook gage. The gage was then adjusted until the reading on the scale corresponded to that for the weir. Readings were taken by different members of the party to insure accuracy.

The flow into the channel was controlled by a valve near the end of the 6-in. pipe line. After adjustment of this valve, approximately fifteen minutes were allowed to elapse to make certain that the flow through the notch was steady before readings were taken. The time interval for each test varied with the head and the size of the notch. Approximately thirty-two tests were recorded for each diameter of opening, two tests being made at each head. Several readings of the hook gage were noted at about equal intervals of time for each test. The time was read on a stopwatch. The discharge from the notch was diverted through the movable apron into the weighing tank during a test and into the reservoir between tests.

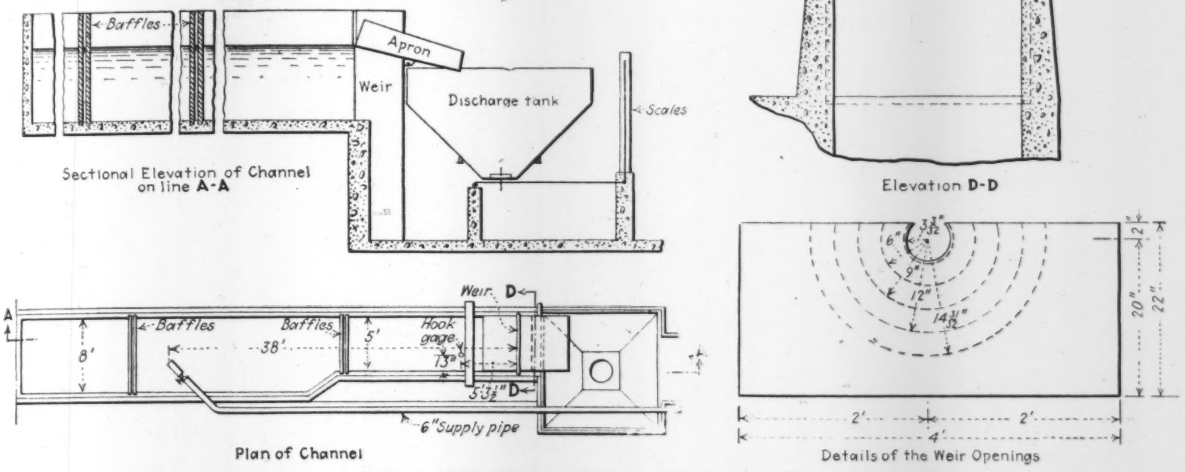


FIG. 1—DETAILS OF THE TANK AND WEIR

Results—Fig. 2 shows the variation of the discharge with the head for the five weirs under test. The graphs were plotted by the centroid method. Briefly, this method consists of first finding the centroid of all the values plotted. The points on either side of this centroid are then treated in a like manner to find their respective centroids. Thus, three points are located that establish the position of the straight line which shows the mean variation of the head with the discharge. The slope of the graph, n, was obtained analytically and checked graphically. The value of n is dependent upon the form of the weir and is uninfluenced by the size of the weir.

The graphs are practically parallel, the small variation in the slope being noted in the table, along with the values of the coefficient m. The values of m and the diameter of the notch, d, when plotted on logarithmic paper seemingly give a straight-line graph. If this relation be true, then the coefficient bears a constant ratio to the diameter, being influenced only by the size of the opening for this particular type of weir. The equation representing this relation can be written,

$$m = c(d)^s \qquad (2)$$

where c is a constant coefficient and s is the slope of the graph with the d axis. The values of c and s have not been listed, it being deemed desirable to make further experiments as a check. When these values have been determined for more weirs, the discharge for a semi-circular weir may be computed by the formula,

$$q = c(d)^s(h)^n \qquad (3)$$

$$\text{Log } q = \log e + s \log d + n \log h \qquad (4)$$

The only variables in the equation will be the head and the diameter. Tables of coefficients will be unnecessary, enabling the flow to be easily calculated through notches that have not been calibrated.

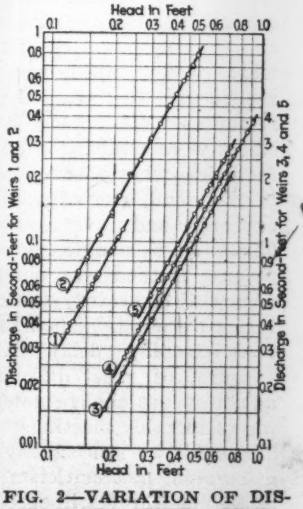


FIG. 2—VARIATION OF DISCHARGE WITH SEMI-CIRCULAR WEIRS

The author was ably assisted in this work by H. S. Hicks, instructor in the hydraulic laboratory, and by F. Parnell and J. H. Leonard, seniors in the School of Civil Engineering.

Pennsylvania Queries Engineering Education

The University of Pennsylvania alumni are being circularized by a committee for suggestions for improving the methods of the course in civil engineering or improving the subjects taught therein.

U. S. Army Engineer at Chicago Reports on Water Diversion

Suggests Compromise Permitting 8,500 Sec.-Ft. Through Canal—Notes Desirability of Saving and Filtering Water

A FULL STATEMENT of the diversion of water from Lake Michigan by the Sanitary District of Chicago has been prepared by Maj. Rufus W. Putnam, Corps of Engineers, U. S. A., district engineer, U. S. Engineers Office at Chicago. The 123-p. typewritten report which was prepared in 1923 has only recently been made public. It is being printed and should soon be available for distribution.

Major Putnam has taken up for the first time the water-waste factor evaluating the saving that might be effected both by the water department and by the Sanitary District. A 25 per cent reduction in cost for sewage treatment works is indicated amounting to $16,000,000 if applied to all proposed plants. Operating costs would be reduced by $2,000,000 annually. The per capita sewage volume reduction is estimated at 89 gal. from a total now of 289 gal.

The simplest protection against reversed flow of the Chicago River into the lake is held to be a movable gate or dam at the mouth of the river. It would need to be operated less than half a dozen times per year with the 8,500 sec.-ft. which Major Putnam proposes as a compromise amount of diversion to be allowed at present. However, the ultimate solution, in his opinion, is to filter the water supply, the cost of which would become feasible from the savings by metering.

Conclusions on other points given in the report are as follows:

This diversion has lowered the levels of the Great Lakes and connecting channels to the positive detriment of navigation interests.

This diversion permanently decreases the amount of water power available to the nation, not an insignificant loss at the present time but of large proportions in the future.

This diversion causes damages which have given rise to considerable complaint in the Illinois River valley by way of flooding bottom lands and increasing the cost of levees.

The nuisance created along the Illinois and Des Plaines Rivers by the sewage introduced therein is not intolerable. No harm will be done if conditions get no worse.

The flow added to the discharge of the Illinois and Mississippi Rivers is of some benefit to navigation. Ultimately the Main Channel and the Sag Channel will be of considerable value as parts of a through barge waterway from Chicago to the Mississippi River.

The Sanitary District trustees have prepared and adopted a program of sewage treatment by methods other than dilution which precludes the necessity of making any substantial increase in the amount of water diverted notwithstanding the increase in population of the District.

The present consumption of water in the city of Chicago is enormous. It can be reduced from about 275 gal. per capita per day to about 125 gal. by installing a system of universal metering.

The saving in pumping costs effected by metering will finance a complete filtration system for the city. The reduction in water consumption by reducing the amount of sewage will permit a reduction in the cost of sewage treatment plants of about $20,000,000 and prolong the life of those completed.

Filtering the water supply will eliminate the dangers attending the discharge of the Chicago River into the lake in times of flood. This economical method of relief from this danger is available to the community.

The reversal of the flow of the Chicago River in times of flood may be prevented by a flood-gate or movable dam installed near the mouth of the stream and closed only when necessary to keep sewage out of the lake. This method is of more immediate application than filtration of water, but might affect navigation.

The reduction in the cost of sewage treatment projects resulting from a reduction in the consumption of water will make it possible to complete the treatment program of the Sanitary District by 1940 instead of 1945, as now planned by the trustees.

This program can be safely and effectively carried out with a water diversion not greater than 8,500 sec.-ft. gradually reducing to 4,400 sec.-ft. or lower as treatment plants are installed.

With these increments from Lake Michigan it will be feasible and economical to complete an 8-ft. or a 9-ft. project in the Illinois River.

The cost of an 8-ft. or 9-ft. channel for the waterway of the state of Illinois will be increased as the diversion diminishes, but not materially.

Restoration of levels of the Great Lakes by means of compensating or regulating works is an international question and includes other considerations than those affecting the sanitation interests at Chicago. This subject should be left out of any agreement with the Sanitary District, excepting by way of guaranteeing their sharing in the expense of construction of these works, otherwise the United States might become involved in embarrassing obligations.

Heavy storm runoffs from the Chicago River watershed have frequencies of 4,167 sec.-ft. seven to eight times per year; 5,000 sec.-ft. five to six times; 7,500 sec.-ft. three to four times; and 9,500 sec.-ft. twice in three years. That, in consequence, positive assurance against discharge of the Chicago River into the lake under present conditions would require a flow in the neighborhood of 10,000 sec.-ft. at the time of maximum flood is Major Putnam's statement under a chapter on "Protection of Chicago's Water Supply." However, he believes that with a little vigilance on the part of employees of the city, Sanitary District and U. S. Weather Bureau larger storms can be anticipated and the flow increased to a maximum of 12,500 sec.-ft. from the 8,500 sec.-ft. which he recommends to be "about as low a discharge as may be used safely without a flood-gate."

Maryland Health Bureau Engineers

Changes in administrative methods in the Engineering Bureau of the Maryland State Board of Health during 1923 included the abandonment of district offices and the concentration of the engineering staff at Baltimore. Commenting upon this change in his annual report for the year, Abel Wolman, chief engineer, remarks: "It should be remembered that resident offices were established during a period of poor transit facilities, whereas the present excellent road facilities in Maryland, ever expanding, make such resident offices expensive and unnecessary." While branch engineering offices were abandoned, with improved efficiency, the reverse method was employed for increasing the efficiency of laboratory work; that is, five branch laboratories were established in different parts of the state, thus lessening "delays in transit of samples, formerly a source of great difficulty to the bureau." Another advantageous change noted by Mr. Wolman is the holding of monthly meetings of the entire engineering staff. These fill at least a day and are devoted to review, discussion, and criticism of administrative procedure, as well as lectures in special fields of sanitary engineering practice.

Difficult Surveys and Deep Cuts on New Coast Highway

California Boulevard Follows Rugged Shore Line—Surveyors and Drillers Lowered from Tops of 200-ft. Cliffs

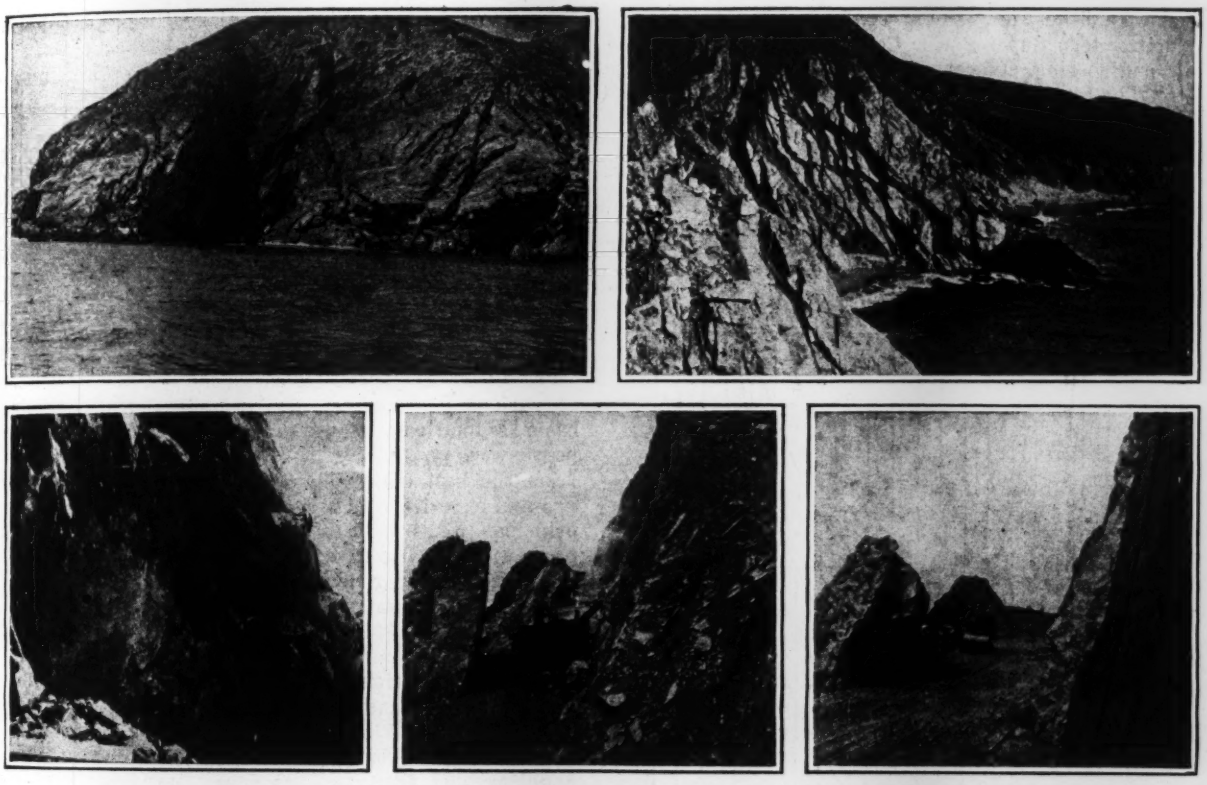
UNUSUAL difficulties were encountered in surveying the route and in starting the grading on the state highway now under construction along the California coast between Oxnard and San Juan. The road here is located along the face of a steep cliff and men had to be lowered as much as 200 ft. on ropes to their work where they faced the dual menace of rocks falling from above and of themselves falling into the surf below. Particularly in that portion of the work south of Point Mugu, the dangers were such that the work was carried on only with picked crews. The following description of conditions and methods is taken from a letter in which the engineer in charge reported on the work to the chief engineer of the highway commission of the state.

At some points the road was located 50 ft. above mean sea level because in time of storm waves that dashed against the foot of the cliff would menace a road at lower level. In some places the cut had to be started as much as 170 ft. above grade to get a sufficient portion of the roadbed on excavated ground. The average slope of the cliff was frequently one-quarter or one-half to one with a broken and uneven contour.

About 100,000 cu.yd. of material, mostly solid rock, was excavated in a distance of less than 4,000 ft. Frequently, where the water was deep at the foot of the cliff, thousands of cubic yards of rock were wasted before the slope of the fill finally became flat enough to withstand the pounding of the waves. The minimum width of completed grade was 30 ft., and as a rule at least two-thirds of this width was on excavated ground.

At one particularly bad location where a bench had to be blasted out as a starting point for further work, none of the experienced drill runners would go down on ropes to do the work. This situation was met and the threatened delay averted by the foreman and one other man, a truck driver, who were lowered about 200 ft. from the brow of the cliff in cradles from which they drilled and shot six 30-ft. holes. This established a bench from which further work in this section was conducted.

Great care was required in handling the powder in order to get the maximum size rock for use in heavy riprap and at the same time to avoid shattering the slope of the cut in a way that would have constituted a menace later from loosened fragments that might fall upon the road. The bulk of the blasting was done with black powder. Hand-grenade powder made up into cartridges was found valuable for springing holes and for mud blasting but was unsuitable for heavy shots as it shattered the rock too badly.



CONSTRUCTION VIEWS OF HIGHWAY ALONG RUGGED CALIFORNIA COAST

New York State Town Highways Get $2,530,897

By the appropriation made by the New York State Legislature in 1924 under what is known as State Aid for Town Highways, the 1923-1924 allotment received by fifty-six counties in the state totaled $2,530,897. Suffolk County had the largest appropriation, $162,949.

Engineers' Committee Reports on Northeastern Super-Power

Comparative Costs of Power Through Combination of Different Sources—Transmission a Controlling Factor

TO AID in the attainment of a complete super-power system for the Northeastern States, Secretary Hoover, in October, 1923, called a conference of the public utility commissioners of the several states in the northeastern part of the country to determine what steps could be taken to further the advancement of power development by co-operation between state and federal authorities. This conference organized the Northeastern Super-Power Committee which appointed an engineering sub-committee to report on the outstanding features of super-power in the New England and Middle Atlantic States. The personnel of the sub-committee is made up of state engineers or an engineer appointed to represent them from the several states concerned and federal engineers to represent the federal bodies. The maps and correlated information for the committee's report were prepared under the direction of Col. William Kelly, chief engineer of the Federal Power Commission.

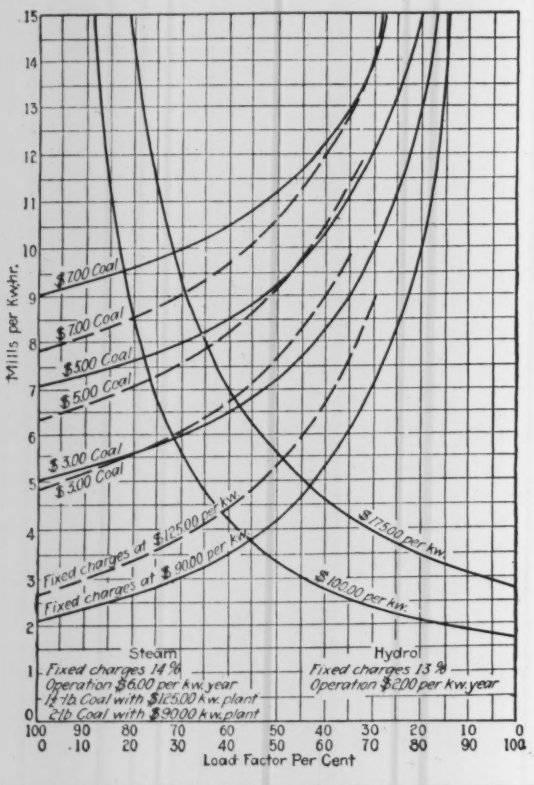


FIG. 1—PRODUCTION COSTS FOR STEAM AND HYDRO POWER COMPARED

The sub-committee's report summarizes the present situation in regard to power development and the interconnection of sources of power and predicts the demand for power to 1935. It also gives data concerning the amount of this power that can be supplied from hydro-electric developments, comparative costs of hydro and different classes of steam power, transmission costs, and production costs for steam power. Some of the curves and diagrams which accompanied the report, which are of special interest to civil engineers, are reproduced herewith.

Basic Assumptions and Cost Data—In order to reach

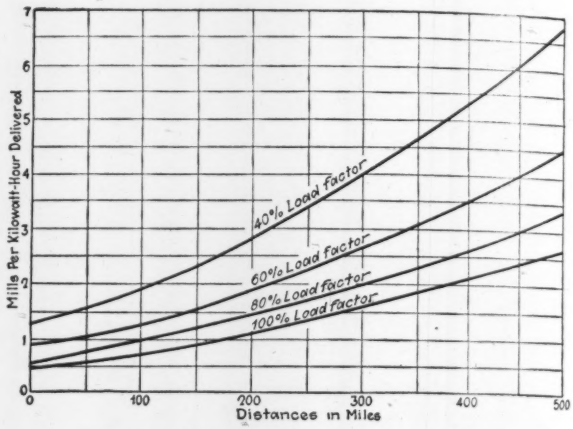


FIG. 2—TRANSMISSION COSTS BASED ON 75 PER CENT CAPACITY FACTOR

conclusions as to the effect of mouth-of-mine plants, local hydro-electric plants, and large water-power sources such as the St. Lawrence, on the cost of power at various load centers, the committee made certain basic assumptions. These assumptions as to the cost of power were prepared by the Federal Power Commission from the best obtainable information on recent practice and experience of large operating companies. The principal items are as follows: (a) Steam power production costs: construction cost of new modern high-pressure plant per kw., $125; construction cost for average steam plant now producing power at large load centers per kw., $90; fixed charges per annum, 14 per cent; operation and maintenance per kw.-year demand, $6; coal consumption of modern plant per kw.-hr., 1½ lb., and for older plants, 2 lb.; price of coal at mine per 2,000-lb. ton, $2.50; freight and handling charges for plant at mine per 2,000-lb. ton, 50c., and storage, handling and insurance at large load centers, 30c. Freight rates per ton for points away from the mine were based on existing schedules. (b) Water-power production costs: St. Lawrence and Niagara power construction costs per kw. installed, $100; local hydro construction, $175; fixed charges per annum, 13 per cent; operation and maintenance per kw.-year, $2. (c) Transmission, in units of two circuits: Annual capacity factor (1 spare in every 4), 75 per cent; annual load factor, 70 per cent; voltage, 220,000; capacity per circuit, 150,000 kw.; cost of line per circuit per mile, $17,000; right-of-way per mile for two circuits, $5,000; high-tension substations at power house at $5.50 per kw. per circuit, $825,000; substation cost at $12 per kw. per circuit, $1,800,000; condenser cost per circuit per mile—$7 per kw.—capacity 0.002 kw. per kw.-mile, $2,100; switching stations to divide the two circuits into sections not to exceed 100 miles in length, per station, $250,000; two circuit telephone lines per mile, $1,200; cost per kw. capacity is estimated by the following, where n = the number of miles and m the number of switching stations:

$$\frac{825{,}000 + 1{,}800{,}000 + n\left(17{,}000 + \frac{5{,}000}{2} + 2{,}100 + \frac{1{,}200}{2}\right) + \frac{250{,}000}{2}\,m}{150{,}000 \times 0.75}$$

$$= \$23.33 + 0.197n + 1.11m$$

(d) Transmission losses: 100 miles = 8 per cent; 200 miles = 10 per cent; 300 miles = 13 per cent; 400 miles = 17 per cent; 500 miles = 21 per cent.

Large Steam Plants at the Mines—Consideration has been given to the construction of large generating stations in the coal areas of western Pennsylvania and West Virginia, from which power could be transmitted to the large load centers. Because of lack of sufficient condensing water elsewhere the problem resolves itself into a determination of the advisability of building large steam plants on the Ohio River in the Pittsburgh-Wheeling region and transmitting the power at high voltage to load centers at Philadelphia, New York, Baltimore, etc. Comparisons have been made between the cost of such power delivered at these cities from a plant on the Ohio River at a 70 per cent load factor, with the cost of power generated at each point at the same load factor by a plant equal in cost and efficiency with the plant at the mine. These figures and similar figures for hydro-electric power on the basis of large plants such as those proposed for the St. Lawrence River compared with local plants, have been superimposed on the map of the Northeastern States in Fig. 3 for comparison. When it is realized that not over 30 per cent of the kilowatt-hours consumed can be economically supplied at the high load factor of 70 per cent assumed for the steam plants at the mines and when, in addition, the difficulties incident to high transmission are considered, it is safe to say that the local plants will be favored, except when a material saving can be shown. Under present conditions, it is not likely that power from plants at the mine will be

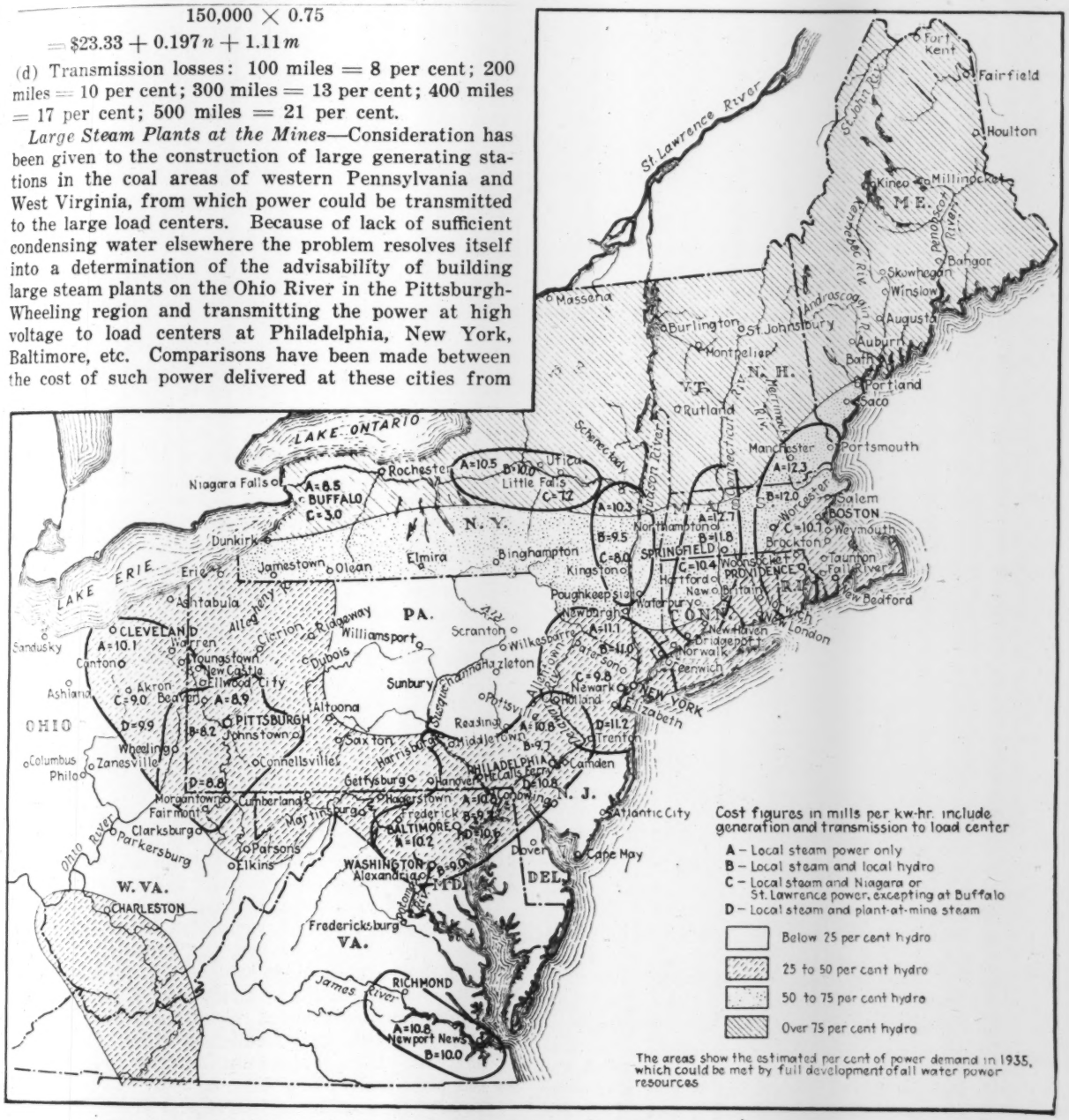

St. Lawrence River
LAKE ONTARIO
LAKE ERIE
OHIO
N. Y.
PA.
W. VA.
VA.
MD.
DEL.
N. J.
CONN.
R. I.
MASS.
N. H.
VT.
ME.
Cost figures in mills per kw-hr. include generation and transmission to load center
A – Local steam power only
B – Local steam and local hydro
C – Local steam and Niagara or St. Lawrence power, excepting at Buffalo
D – Local steam and plant-at-mine steam
Below 25 per cent hydro
25 to 50 per cent hydro
50 to 75 per cent hydro
Over 75 per cent hydro
The areas show the estimated per cent of power demand in 1935, which could be met by full development of all water power resources

FIG. 3—COMPARATIVE COSTS OF HYDRO AND STEAM POWER, AND EFFECT OF COMPLETE DEVELOPMENT OF WATER POWER

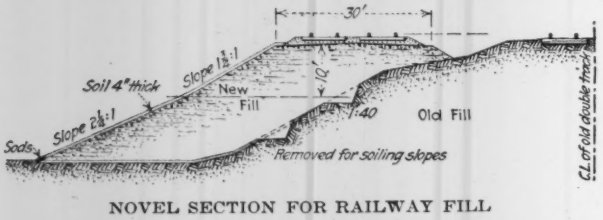
Heavy type figures give cost in mills of power from available sources in their respective portions of the areas surrounded by heavy lines. Shading indicates percentage of estimated power demand in 1935 which could be supplied by complete development of all water resources in this section of the country.

transmitted to distances greater than 200 miles. Another factor which is unfavorable to the combination of different sources is that, in the case of large hydro plants on the St. Lawrence or at Niagara and plant-at-mine power, the long distance transmission necessitates operating on a high load factor, which means that a base load must be carried and that only a part of the load can be carried from these sources. The local steam or hydro plants are thus put on a poor load factor, which increases the cost per kilowatt-hour from them at a rate which will eventually offset the advantage to be had from absorbing power from the cheaper but distant source.

However, there are certain advantages to be gained from the development of mouth-of-mine and all available hydro-electric power that do not show directly in figures for the cost per kilowatt; they are an estimated saving of 50,000,000 tons of coal annually, security in power supply, larger reserves of power, and increased efficiency through the electrification of industries now operated in other ways.

Railway Fills with Double Slopes

AN UNUSUAL embankment section, having a flatter slope for the lower portion in order to increase the base width, has been used by the London & Northeastern Ry., England, in the recent four-tracking of a part of its main line. In this work, shown in the accompanying drawing, the lower part of the fill is formed with a slope of 1 on 2¼ but for the top 10 ft. of its height the slope is 1 on 1¾. The slope of the adjacent existing fill was stripped of the surface soil, to be applied on the new slope. Two benches were cut to give



NOVEL SECTION FOR RAILWAY FILL

a bond with the new material, as shown, the bottom of each bench having a slope of 1 in 40 to prevent pocketing water.

This form of section was made practicable by dumping material from a surface track which was raised with the fill. Thus the material was deposited in horizontal layers and the fill was more dense and substantial than if made by dumping over the side of the old fill.

In the latter method, much material is wasted and the loose inclined layers are subject to extensive wash by rain, besides cracking and slipping away from the old slope as water works along the face of the latter.

On this English work, the 30-ft. roadbed has a slope of 1 in 45 each way from the center and the shoulders are covered with 6 in. of gravel outside of the ballast toes. Stone ballast 2 ft. deep is applied, level with the tops of the ties and shouldered out 12 in. beyond the ties. The tracks are spaced 11 ft. 2 in. c. to c. Brick arch bridges of three to seven spans are used extensively on this new work, where concrete would be used in American practice. The improvement is being carried out under the direction of C. J. Brown, chief engineer.

Garbage Collection and Disposal in a Hundred Manager Cities

OF EXACTLY 100 municipalities ranging in size from Dayton, Ohio, down to small villages, operating under the city manager plan, the garbage is collected by the city in 65 places, by contractors in 23, and by "private persons" and "scavengers" in 11, leaving only one place for which the information is not available. These and the other figures mentioned below have been taken from the July number of the *City Manager Magazine* (Lawrence, Kan., City Managers Association).

Garbage and trash are collected separately in 66 of the places, are not separated in 33 and there is no report from one city.

Flytight containers are reported for 87 of the communities, while 12 answer "no" to the question on this subject and one did not report.

Frequency of collection was reported separately for the residence and the business districts and shows much diversity, particularly in residence districts. The most common frequency of collection in the residence district was twice weekly—32 cities. Taking into account 12 places in which the garbage is collected three times a week and 3 in which it is collected daily, 58 of the 100 municipalities had a collection at least twice a week. One city each reported collections every four days, every five days and twice a month, while 2 reported that collections were made on call or by request, and for another 2 no information was given. In the business district, 66 of the cities reported daily collections, 11 collections three times a week and 12 twice a week, while one reported from three to six times a week, 6 weekly, one no collections in the business district and 3 made no report.

Vehicles used for collection purposes were reported as trucks (presumably motor trucks) in 52 places, wagons in 43 (presumably meaning horse-drawn vehicles including 5 "tank wagons," 2 "carts" and 1 "team"), while 2 places stated that both trucks and wagons were used, and 3 places did not report. The given haulage ranged from ½ mile to 16 miles, with some 75 to 80 places reporting a haul of 3 miles or less.

The method of disposal most commonly reported was hog feeding by 32 cities; some kind of burning by 31 (incineration, 16; cremation, 1; "burned," 14); land disposal, 27 (dumping, 14; sanitary fill, 10; buried, 3). Disposal for fertilizer was reported by 4 and reduction by 2 cities making 6 which reported some sort of utilization, other than hog feeding, or 38 if hog feeding is included. Both feeding and burning were reported by one place and 3 places did not report on this subject.

Reports on cost of collection and cost of disposal were scanty. About 35 cities reported a unit cost of collection of from $0.35 to $5.80 per ton. Fourteen cities reported the unit cost of disposal, the lowest being Portsmouth, Va., at $0.21 and the highest Sewickley, Pa., at $4.40 a ton, incineration being the practice.

Populations are not given in the table from which the foregoing figures were taken, and the arrangement is entirely haphazard, as to size, alphabetical order and location, thus rendering further summaries impossible without rearranging the table. All the summaries here given have been made up for this article from the original data, which was not summarized.

Vitrified Tile Liners Used in Los Angeles Sewers

Trunk Sewers 50 Miles Long and Septic Condition of Sewage Led to Use of Special Lining in Concrete Pipe

VITRIFIED TILE liners are being used in all main trunk line sewers of Los Angeles because of the belief that under Los Angeles conditions the life of the sewers, at least in some cases, may be prolonged by the tile liners.

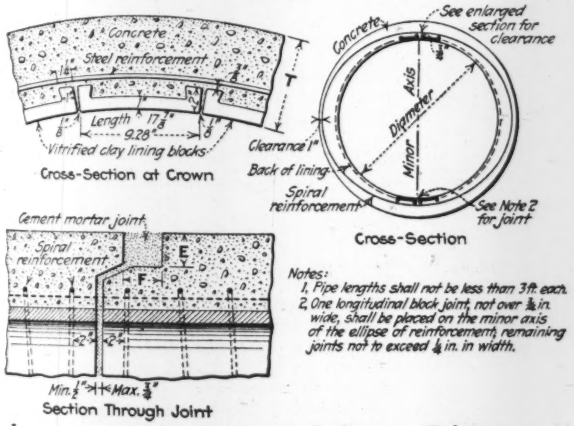
From the upper end of the present trunk lines, at points where the diameter is 36 to 42 in., sewage must travel 50 miles to the ocean outfall and the long detention while sewage is traveling this distance results in a septic condition and the formation of sulphuric acid which has in some cases attacked the concrete. While this damage has not been extensive, still, in planning the extensive sewer system now under construction and because of the very long period of detention it was felt safer to use the tile liners in the trunk sewers.

These liners are not being used in sewers where less than 4 to 6 hours' detention of sewage is likely to occur, nor on the bottoms or lower parts of the larger trunk lines which will always be below flow level. To avoid lining the smaller sizes of concrete pipe and where the strength of reinforcing that can be used in concrete pipe was not needed, large size vitrified pipe has been used. By special arrangement with local vitrified pipe manufacturers the city is obtaining this kind of pipe in diameters up to 30 in.

The city reports that the cost of the precast concrete pipe with tile liners, delivered on the work, is as given in the following table:

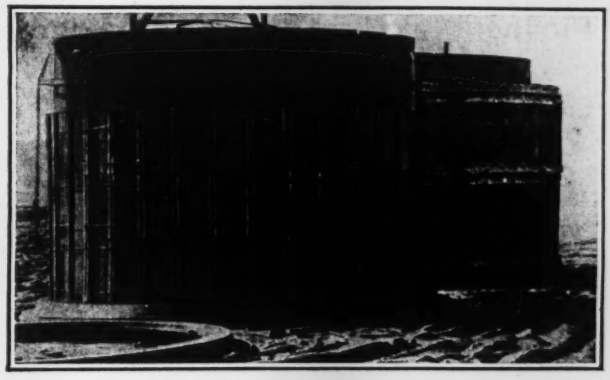
Size of Pipe	Price per Foot
4 ft. 9 in.	$12.60
5 ft. 3 in.	15.60
6 ft. 0 in.	19.95
6 ft. 3 in.	21.55
7 ft. 6 in.	28.90
8 ft. 6 in.	35.25

The accompanying drawing shows the details of the precast pipe with the tile liners and the two views show the pipe under construction and a finished large diameter pipe.



Inside Diameter of Pipe, In.	T Thickness, In.	Joint Dimensions E In.	Joint Dimensions F In.	Steel Reinforcement Number of Coils per Foot	Steel Reinforcement Diameter of Wire, In.	Radius of Each Segment Lining Block, In.	Number of Blocks per Circle
57	5½	2½	2½	4	⅜	27	19
60	6	2½	2½	4	⅜	27	20
63	6½	2½	3	3	½	27	21
66	6½	2½	3	3	½	27	22
69	6½	2½	3	3½	½	27	23
72	7	2½	3	3½	½	27	24
75	7½	2½	3½	3½	½	27	25
78	7½	2½	3½	4	½	27	26
81	7½	2½	3½	4	½	27	27
84	8	2½	3½	4	½	45	28
87	8½	2½	3½	4½	½	45	29
90	8½	2½	3½	4½	½	45	30
93	8½	3	3½	5	½	45	31
96	9	3	3½	5	½	45	32
99	9½	3	4	3½	⅝	45	33
102	9½	3	4	3½	⅝	45	34
105	9½	3	4	4	⅝	45	35
108	10	3	4	4	⅝	45	36

DETAILED SECTIONS OF TILE LINED PRECAST CONCRETE PIPE FOR LOS ANGELES OUTFALL SEWER



CLAY FILL LINERS IN PLACE ON CONCRETE PIPE FORM

A FINISHED CONCRETE PIPE WITH CLAY LINER

Five Companies Supply Water in New York

Five water companies still supply water under franchise grants in parts of New York City: Jamaica Water Supply Co., Queens County Water Co., Woodhaven Water Supply Co., the Urban Water Supply Co., and the Flatbush Water Works Co. On Dec. 31, 1923, these companies owned, altogether, 670 miles of mains against 3,461 owned by the city. The latter figure includes 198 miles of mains taken over by the city from the Citizens Water Supply Co. in 1922.

Further Notes on Tornado Damage at Lorain, Ohio

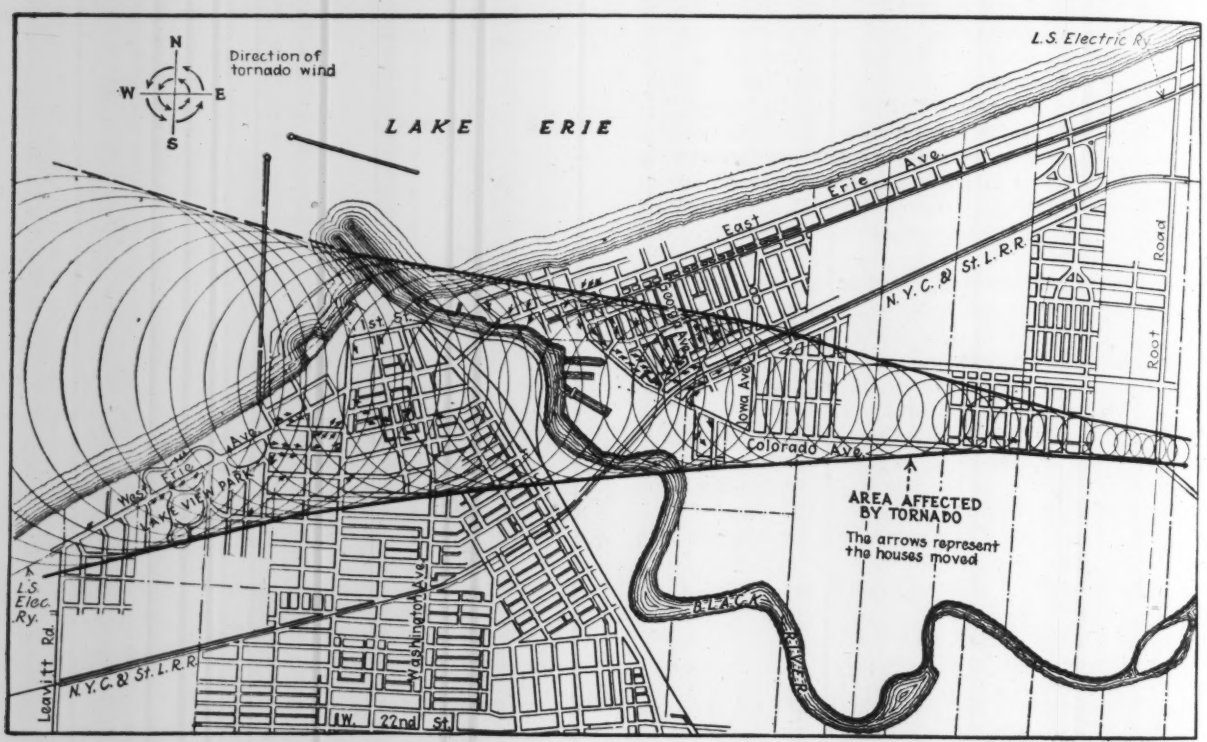
Little of Structural Value Adduced—No Definite Conclusions Possible as to Resistance of Various Building Materials

EXAMINATION of the wreckage and study of the general effects of the tornado which passed over Lorain, Ohio, coming from Sandusky and Avon, on June 28, adduces little in the way of the effect of tornadoes upon different types of structures and resistance offered by the various building materials, is the opinion of C. C. Miller, city engineer of Lorain, who sets forth as follows the result of his observations in Lorain.

Mr. Miller explains that the tornado was of the usual funnel shape: That it had a breadth of some 6,000 ft. at the western limits of the city and only 500 ft. at the eastern limits. Uniform contraction of the width occurred, judging from damage done, between the east and west ends of Lorain. In the accompanying figures it is easily seen what type of tornado it was from the nature of the damage done. Though the magnitude of the tornado can be traced by following the path of destruction, Mr. Miller reports that no structural facts concerning tornado damage are possible for "what was proven in one block was disproven in the next," and that, as most of the buildings destroyed were residential, these were either blown from their foundations by the direct thrust of the wind, or "exploded" because they lay within the vacuum areas of the tornado, or that they were lifted vertically. Parts of Mr. Miller's report to *Engineering News-Record* follow:

The storm has been traced from Sandusky, about 30 miles west of Lorain, to Avon village, about 20 miles east of Lorain. After the storm had reached Sandusky it apparently descended and was at its lowest point between Lorain and Sandusky, in Lake Erie. As it proceeded eastward and reached the shores of Lake Erie in the vicinity of Lake View Park (Lorain) it started to rise across Lorain. When the storm reached the easterly limits of the city it was at such an elevation that no damage was done on the surface of the earth. In the vicinity of Avon it again descended and considerable damage is reported from that section.

From a study of the devasted area within the limits of Lorain, it is very apparent that the storm was of the usual



TORNADO'S PATH THROUGH LORAIN; WIDTH OF DAMAGE D AREA 6,000 FT. AT WEST, 500 FT. AT EAST END OF CITY

funnel shape. There is no other conceivable shape which would leave a path 6,000 ft. wide at the westerly limits of the city, and 500 ft. wide at the easterly limits, which path uniformly contracted between the two points. And there is no way that a funnel-shaped tornado could leave such a path without gradually rising or falling in the direction, respectively, of the smaller or larger area.

The direction of the storm, which, through Lorain, was almost due east is not disputed as this is easily proven by comparing the time at which it reached Sandusky, Lorain, and Avon.

After surveying the types of failures it is found that, in general the exploding buildings lay both along the center line of the storm and along the outer edges. This would seem to indicate a vacuum extending through the center of the whirling mass of air and one immediately outside of the whirling mass.

It will be noted in Fig. 1 that the houses in the westerly section of the city were moved practically all in the same direction. This is due to the large diameter of the storm at this point. On the easterly side of the city, where the diameter was small, the tail of the tornado alone was the effective part. Here the buildings were moved in nearly every direction.

The proof that the storm was a whirling mass of air is shown by the fact that furniture and smaller buildings were first thrown to the north and immediately houses and

buildings were demolished by a stronger wind coming from the north. The wind when moving in the same direction as the storm, was very much more intense than when the wind traveled in a direction opposite to that of the storm.

Sandusky Water-Works Quickly Put in Service After Tornado

THE TORNADO which passed over Sandusky, Ohio, on June 28 apparently struck the water-works of that city squarely, according to notes on the disaster submitted to the city authorities by F. H. Waring, principal assistant engineer of the Ohio State Department of Health. The 25x180-ft. standpipe, with a capacity of 600,000 gal., was blown over. The standpipe was empty at the time, as its interior was being painted. The tall brick chimney of the pumping station was also blown down; the roof of the pumping station was stripped and the rear wall of the filter house blown out. One of the steel trusses at about the center of the building was torn loose and deposited within the filter house, crushing two operating tables. The air compressor used in washing the filters was wrecked, the steam lines supplying the air compressor and the low-service pumps were broken, the blower for operating forced draft under the boilers was injured by falling stone, the coagulant tanks were filled with débris, the orifice box shattered and the solution lines destroyed, the chlorinating machine was wrecked, and all the filters were filled with such débris as brick, pieces of timber, stones and slate.

During the evening after the disaster, a local plumbing concern worked voluntarily to repair the steam lines and the blower for forced draft. A local boiler concern worked continuously, erecting a temporary stack for firing the boilers. These repairs were completed about Sunday noon (the day after the tornado) and steam was then raised for operating the pumps.

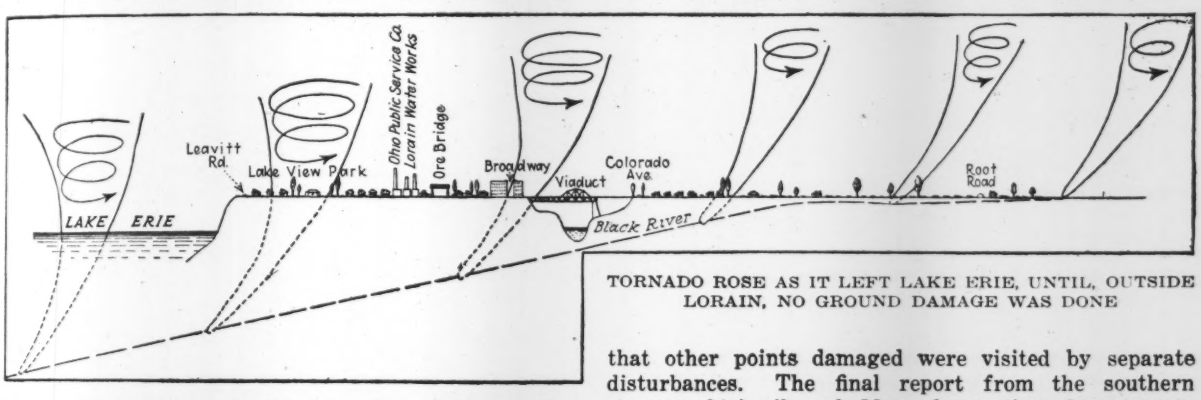
No injury was done to the pumps; there were two 6-m.g.d. low-service pumps and a 7.5- and a 10-m.g.d. high-service pump. The clear-water reservoir was found practically full.

With the assistance of a company of national guard engineers, the filter house was cleared of débris in about six hours. Early Sunday morning overhauling of the filters was undertaken. By 6 p.m. Sunday, two filters were in service, five by 9 p.m., and seven by midnight. The three others will remain disabled until permanent repairs can be made. Filtered water was pumped from the clear-water reservoir about three hours before the first filter was restored to service. The liquid chlorine apparatus having been wrecked, chloride of lime was secured in limited quantities from wholesale houses in Sandusky and applied to the raw water with sulphate of alumina, through temporary piping, both solutions being roughly gaged. New liquid chlorine apparatus, not yet unpacked, was located at the Rye Beach sewage-works, ten miles from Sandusky. This was obtained, installed, and at 2:30 p.m. Monday was in service. Meanwhile more chloride of lime had been shipped in from Toledo. Although no bacterial tests were possible before Tuesday, it is believed that all water pumped to the city was of a satisfactory sanitary quality.

O. F. Schoepfle, chemist in charge of the purification plant, deserves high credit for his work in placing the plant in operating condition. The assistant pumping engineer, Mr. Holzmiller, also rendered valuable service.

Weather Bureau's Storm Report

PRELIMINARY reports to the Weather Bureau indicate that several tornadoes were active in the lower Lake Erie region at the time such destruction was wrought at Sandusky and Lorain. While it is possible that the tornado which visited Sandusky moved in practically a straight line eastward to Lorain, it is known that other points damaged were visited by separate disturbances. The final report from the southern storms of April and May shows that 21 separate tornadoes contributed to the April disturbance and 12 to that of May.



TORNADO ROSE AS IT LEFT LAKE ERIE, UNTIL, OUTSIDE LORAIN, NO GROUND DAMAGE WAS DONE

The final report on the Lake Erie storms will not be complete until Aug. 1, but the Weather Bureau has received a preliminary report of which the following is an extract:

At about 4:30 p.m. dark stratus clouds were observed moving from the southwest and northwest and meeting at a point over Lake Erie north of Sandusky. At the junction of the two cloud streams the clouds presented a bluish-black appearance and a cloud whirl was seen plainly. At about 4:35 p.m. the storm seemed suddenly to move southeastward over the water to the land and then almost directly eastward for a distance of one-half mile. It then passed again into the lake.

The wind, which had been from the southeast immediately before the storm broke, suddenly shifted to the northwest and storm winds prevailed from 4:35 to 4:40 p.m., a maximum velocity of 72 miles for five minutes and at the rate of 77 miles for one minute being recorded. Heavy rain began at 4:35 p.m. and continued until 8:15 p.m., the total precipitation during the period being 1.41 in. The temperature fell from 83 to 69 deg. F. A funnel-shaped cloud was observed to touch the ground. The explosive effect associated with tornadoes was clearly evident in many of the buildings that were destroyed.

There is no further record of the storm after it passed into the lake. However, it is probable that it was this same storm that caused so much damage at Lorain, Ohio, on the afternoon of the same day. Lorain is 32 miles east of Sandusky. Other storms of great intensity were in the vicinity of Castalia, Vickery and Whitmore, small towns six to fifteen miles southwest of Sandusky.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Making Stresses for Brick Masonry

Sir—Referring to an item in your issue of July 3, p. 6, in the report of the meeting of the American Society for Testing Materials, stating that the results of compression tests of brick masonry reported by me indicated a necessity for lower working stresses than now generally allowed, reference is had to the table of average results published in your issue of July 10, p. 66. With brick that would be given a classification equivalent to "medium" under A.S.T.M. specifications, the masonry strength for brick laid flat in cement-lime mortar ranged on average values from 513 to 940 lb. per square inch, or 37 to 68 tons per square foot. The lowest value with four duplicate tests was 81 per cent of the average value.

The provisions of 15 representative city building codes examined limit maximum working stresses to values from 111 to 160 lb. per square inch for common brick in cement-lime mortar, or 8 to 11½ tons per square foot, the average of the code maximums being 10½ tons per square foot. This gives an average factor of safety of 3½, based on the lowest average test result, and in some cities using brick giving the higher masonry strengths the factor of safety may be as high as 8½. Similar conclusions obtain for masonry laid in lime mortar and in portland cement mortar as it concerns the ratio of test results to working stresses. The lower ratios are comparable with those obtaining for other building materials of as great variability in properties as brick masonry. The higher factors of safety that have been supposed to obtain are based on tests of carefully constructed or selected specimens. As the material and workmanship of the constructions tested more nearly approximate what goes into the building, the margin of safety will appear to be lowered, but this need not cause alarm with factors of safety remaining of the order above indicated.

S. H. INGBERG,
Engineer-Physicist, Bureau of Standards.

Washington, D. C.,
July 24, 1924.

Need of Study of Portland Cement

Sir—I am much interested in the article of Thaddeus Merriman in your issue of July 17, on "Some Requirements in the Study of Portland Cement."

One of his suggestions is that different qualities of cement might properly be used for different purposes. For hydraulic works the prime requirements are impermeability and durability. If these are met it is very rare indeed that there will be deficiency in strength. Tensile and compressive strength have only a remote and indirect bearing upon the value of concrete used for hydraulic purposes.

The case is quite different from that of bridges and buildings, where the requirement of strength comes first, and it may well be that different specifications for cement would be advantageous.

Hydraulic structures built with imported portland cement more than thirty years ago have in general stood well. The same may be said of structures built from the earliest American portland cements which were not very finely ground and in other respects differed from the present product. More recent structures built with cement supposed to be of better quality have not always stood as well.

It is true that the quality of cement is only one of the factors in the durability of concrete; but in thinking over the record of our experiences I cannot help feeling that much of the earlier cement was more durable in hydraulic structures than that which came afterward.

Specifications of thirty years ago did not permit any plaster to be used. Plaster was then considered as an objectionable adulterant. The advantages in the use of plaster with portland cement in temporary architectural works were well known, as, for instance, the staff so successfully used in the construction of the World's Fair buildings in Chicago in 1893, but for durable hydraulic work it was excluded.

Plaster is represented by SO_3 in the cement specifications. Some twenty years ago the use of plaster in cement to control the rate of setting was introduced and standard specifications were drawn to permit and limit this quantity. Recently this limit has been increased by a revision of standard specifications.

Plaster is soluble in 500 parts of cold water and is probably the most soluble element in concrete. It would certainly seem that the addition of 3 to 5 per cent, now permitted, of soluble material was at least taking unnecessary chances with its durability when used in hydraulic work.

Certainly there is need of thorough experimental study of cement and this may well be supplemented by study of actual records of work built with different kinds of cement and standing through a long term of years.

One of the most trying features is that the structures that will disintegrate and be in bad condition after a certain period of years may be turned over by the contractor and may remain apparently in perfect condition through a considerable number of years before deterioration and disintegration are apparent.

ALLEN HAZEN,
Hazen & Whipple, Civil Engineers.

New York City,
July 26, 1924.

Triaxial Diagram for Classifying Asphalt Sands

Sir—Comment is required with reference to the article "Classifying Asphalt Sands by Graphical Method" published in *Engineering News-Record*, June 26, 1924, p. 1090, written by W. C. D. Haarman, consulting highway engineer and member of the board of the D.E.I. Road Congress, Bandoeng, Java.

In the first place, this article seems to be essentially a repetition of Prevost Hubbard's paper "The Selection and Proportioning of Sands for Sheet Asphalt Paving Mixtures," read before the 1922 convention of the American Road Builders Association. The triaxial diagram method used by Mr. Haarman is identical with that given in Mr. Hubbard's paper, which was extensively reprinted by technical journals and was broadcasted by the Asphalt Association. In the opening paragraph of Mr. Haarman's article, he stated that, so far as he knows, this method has not been used for classifying asphalt sands. Further along in his article he refers to the specification limits as issued by the Asphalt Association, which would indicate that he is more or less familiar with the standards recommended by this association. Apparently, however, he is not conversant with Mr. Hubbard's paper published in 1922.

In the second paragraph of Mr. Haarman's article he sets forth the sand gradings recommended by Clifford Richardson as ideal for the two classes of traffic, light and heavy. There is an error in the table showing the mesh. First the 100 and 80-mesh sand is classified as "coarse" and the 30, 20 and 10 sand as "fine." Second, the percentages given under light traffic do not add up to 100 nor do they agree with Richardson's grading as the percentage for 50 and 40 mesh material is given as 25 instead of 45.

The merit of this means of classifying sands is debatable. It is granted that it might be conveniently used by engineers thoroughly conversant with the manufacture of asphalt paving mixtures. It is, however, extremely doubtful whether it could be advantageously used by the average plant inspector with a saving of time. To one familiar with the requirements of sands for this purpose, the old simple arithmetical proportioning seems to be just as accurate and in many cases even more rapid than the triaxial diagram. In the encouragement of the greatest accuracy on the part of field inspectors, it is always desirable to simplify problems of this nature to the last degree; therefore the introduction of formulas, charts, etc., is to be avoided just as far as possible. In the engineering office, this is, of course, not necessarily true. However, I have heard the opinion expressed by numerous engineers that the triaxial diagram method of classifying sands is anything but simple. With this opinion I do not entirely agree, but I have avoided introducing such a method in the field for

the reasons above given. The possibilities of combination of a given number of sands in producing a desired grading is usually so obvious that diagrammatical demonstration is superfluous.

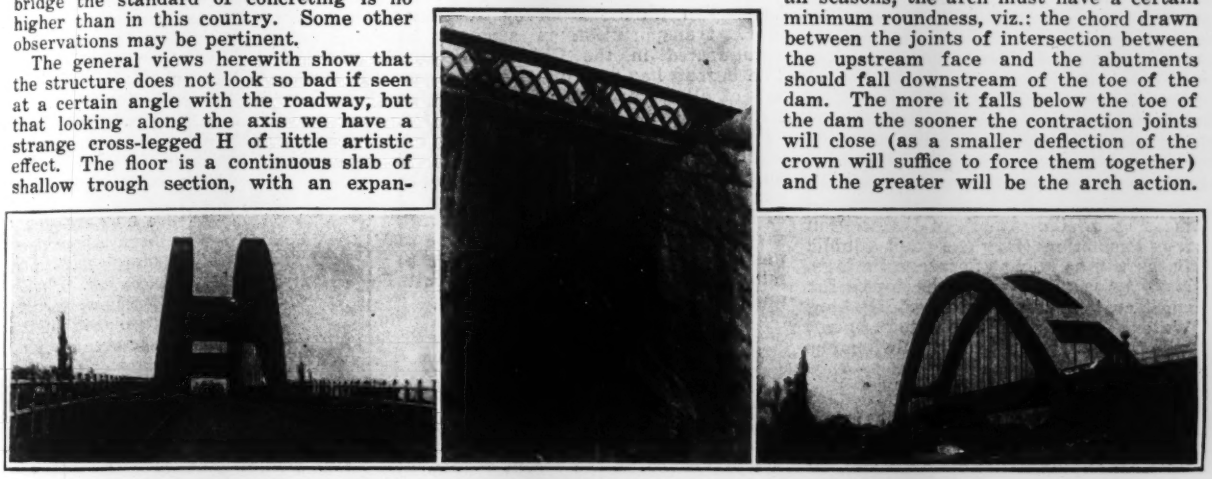
HUGH W. SKIDMORE,
Consulting Engineer.

Chicago, Ill.,
June 28, 1924.

Observations on the Largest Concrete Bridge

Sir—I have recently returned from Europe where I had an opportunity to examine the 432-ft. span concrete arch across the Seine at St. Pierre-du-Vauvray, which was described in your issue of March 20, 1924, p. 476. I found that your editorial assumption was correct that in this bridge the standard of concreting is no higher than in this country. Some other observations may be pertinent.

The general views herewith show that the structure does not look so bad if seen at a certain angle with the roadway, but that looking along the axis we have a strange cross-legged H of little artistic effect. The floor is a continuous slab of shallow trough section, with an expansion joint at one end only, though at the other end for symmetry there are also double floorbeam and hangers. It had been raining shortly before I saw the bridge and there was water leaking through one rib mainly around the hangers, but also through a construction joint, where were white spots apparently caused by former seepage. Inspection showed that the alignment and plumb is not very good. One of the views herewith shows the upstream abutment on the St. Pierre side, at what is probably a construction joint, but what had better be called a crack.



VIEWS OF THE ST. PIERRE-DU-VAUVRAY CONCRETE BRIDGE ACROSS THE SEINE
Left: Looking along the roadway. Middle: Construction joint at abutment looks more like crack. Right: A side view.

A. ESCHER,
Bridge Dept., North Carolina State Highway Commission.

Raleigh, N. C.,
July 15, 1924.

Arch Action in Slightly Arched Gravity Dams

Sir—The writer has read B. F. Jakobsen's article on "Arching Not Effective in Slightly Arched Gravity Dams" in your issue of June 12.

The opinion of civil engineers has for many years been divided on the question of the merits and soundness of the arch dam, and it is only recently that arch dams have been built in sufficient numbers to be of interest. Gravity dams have so far been preferred even in many places where arch dams would have fitted and could have been more economically built.

The main objections generally advanced against arch dams vary all the way from the argument that the arch takes away some of the storage capacity of the reservoir to the declaration by the engineer that he has been against arch dams all his life and it would hurt his reputation to change his opinion now. Against such reasons there is little argument. These reasons are not very technical, but everybody is entitled to his opinion.

Many gravity dams, or so-called gravity dams, have been built arched in plan, and it has generally been assumed that the arch would add to the stability by relieving the cantilever for part of its load. While even a flat arch may sustain some load by arch action in the summer time when the higher temperature expands the concrete material, it cannot sustain any load with the reservoir full during late winter and early spring when the temperature of the dam body is lower than when the dam was built, unless the contraction joints had been grouted previously, and it has so far not been the practice to do so. A flat gravity arch will require too much deformation to close the contraction joints with the reservoir full in the early spring or late winter. All the load is therefore taken by the cantilever even before the joints can close, and until they have closed there can be no arch action. If contraction joints have not been artificially provided, they will have made themselves in case the reservoir was ever empty during cold weather. If this was never the case and no vertical cracks have developed, some actual pulling in a downstream direction is being exerted by the arch which must be sustained by the cantilever with reservoir full during cold weather.

In order to be of material assistance to the cantilever at all seasons, the arch must have a certain minimum roundness, viz.: the chord drawn between the joints of intersection between the upstream face and the abutments should fall downstream of the toe of the dam. The more it falls below the toe of the dam the sooner the contraction joints will close (as a smaller deflection of the crown will suffice to force them together) and the greater will be the arch action. The concrete material is thus utilized in two directions, and hence the safety is vastly greater.

Unless the gravity section is curved in plan so that the toe of the dam falls upstream of the chord between joints of intersection of the upstream face with the abutments, it has no advantages over a straight dam, but to the contrary, as shown by Mr. Jakobsen, and it always has the disadvantage of requiring more expensive formwork and taking more material. To the writer, it has occurred for some time that it would be a better plan to use the excess material in a flat gravity arch in the shape of buttresses, spaced, say 100 ft. apart along the downstream face of a straight gravity dam, thereby increasing the leverage of the tipping resistance a maximum amount for the least expenditure of material, and at the same time keep the factor of safety independent of temperature changes.

LARS JORGENSEN,
Constant Angle Arch Dam. Co.

San Francisco, Calif.,
July 19, 1924.

Decentralizing the City Population

Sir—In reading your editorial of June 26, p. 1084, on "Keeping Automobiles Off the Streets" and similar articles, the thought always occurs to me, since the intense concentration of humanity in large cities results in ever increasing expense, with less comfort, safety or liberty for either automobilist or pedestrian, why should not the engineering fraternity take the lead in turning civilization into a more hopeful avenue, decentralization instead of concentration?

The recent enormous strides in rapid transportation would certainly point in this direction, rather than that cities should defeat themselves by trying to devise further refinements in the art of huddling people together and stacking them up in layers. Is it not time to right about face in the problem of distributing people comfortably and happily over the surface of the earth? To be sure, there are the enormous vested interests in every large city, but if a start were once made in the opposite direction, would they not in the course of a generation or two be reinvested in ways which might contribute more largely to the welfare and happiness of mankind?

A. B. WHITE,
W. E. Wood Co.

Detroit, Mich., June 30, 1924.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

After Having Been In Office five months, the entire city planning commission of Sacramento, Calif., consisting of five members, has resigned. The reason given for the action is that 18 of 24 zoning recommendations made by the commission to the council have been rejected by the latter. Peter J. Shields was president of the commission.

With the Co-Operation of the state conservation commission, the annual meeting of the American Association for Promoting Hygiene and Public Baths will be held at Saratoga Springs, N. Y., Aug. 7. Among the topics for consideration are: Goitre and Drinking Water, Chlorine as a Healing Agent, Industrial Hygiene, and Swimming Pools.

Authority to Abandon 28 Miles of railroad has been asked of the Interstate Commerce Commission by the Chicago, Milwaukee & St. Paul Ry. Co. The line in question extends from Babcock to Tomah in Wisconsin, and serves the towns of Daly, Meadow Valley, Mather, and Norway. The advent of good roads and automobiles has made it unprofitable to operate this line.

The First Unit of the Minnesota Power & Light Company's new $5,000,000 hydro-electric development on the St. Louis River at Fond du Lac, Minnesota, has been put in operation. This first unit has a capacity of 15,000 hp., and provision has been made for the installation of an additional 15,000 hp. unit as soon as needed. The dam is 600 ft. long and 85 ft. high at its highest point.

Tenders for the Construction of 12 miles of railway between Grande Fresniere and Rinfret Junction, Quebec, have been received by the chief engineer of the Canadian National Rys. The estimated cost of the work is $357,000; it has been sanctioned by parliament. Practically all the right-of-way has been acquired, and as the location is through a fairly level country it is expected that the grading will be completed, ready for track laying, by the fall.

An Industrial Fellowship for timber treatment research has been founded by the Mellon Institute of Industrial Research of the University of Pittsburgh; this research, sustained by the Grasselli Chemical Co. of Cleveland, Ohio and conducted by Dr. A. M. Howald, consists of investigational work toward the improvement of methods of applying zinc chloride in wood preservation and increasing the permanence of the treatment by the addition of petroleum oils.

Bureau of Public Roads to Survey Chicago Motor Truck Traffic

Under the direction of Prof. J. G. McKay, chief of the highway economics division of the U. S. Bureau of Public Roads, an intensive survey of motor truck transportation is soon to be inaugurated in the Chicago district. The bureau has now under way a survey of all motor traffic in conjunction with the Cook County Highway Department, which will be used as the starting point for the truck survey both as to extent of area to cover and data available and desirable. Attention is to be paid to organization of trucking service, cost, rates, profit and value to patrons, particularly with reference to milk, packing house products, fruits and vegetables.

Contracts Awarded for Broad Street Subway

The first two contracts for construction of the Broad St. subway under the provisions of the recent municipal loan have been awarded by the Philadelphia Department of City Transit to the Keystone State Construction Co. of Philadelphia. Contract 105A provides for construction of the portion of four-track subway in Broad St. between Stiles and Dauphin Sts., and Contract 105B between Dauphin and Clearfield Sts. The aggregate of the first bid was $7,660,648.50; that of Contract 105B being $6,554,451.50. These two contracts cover a total length of 10,130 ft. of four-track subway, or nearly one-third of the total length of four-track subway to be built in Broad St. Bids were received on July 15, and were asked in two forms. The first form was for the entire work, and the second for either of the two sections. Four bidders submitted proposals. The Keystone State company bid separately on the two sections, and had the low bid. Frederick Snare Corporation, Philadelphia, submitted a bid on Contract 105B only, the aggregate price being $7,937,180. Patrick McGovern, Inc., and Booth & Flynn, both of New York, submitted proposals for the entire work, the aggregate bids being, respectively, $14,800,015 and $15,511,294. The proposals were made on a basis of 100 items, with subdivisions in a number of items. Construction work will be started within a few weeks. The contract date of completion is Jan. 31, 1927.

This portion of the Broad St. subway is the most difficult to construct. It involves an underpass beneath the tracks of the Philadelphia & Reading R.R., which are already depressed beneath the level of the street, and it requires readjustment of a number of other important underground structures.

Injuries Received in Wreck Fatal to John H. Dunlap

Am. Soc. C. E. Secretary Dies After Month's Illness—Funeral Today —Elected in 1922

John H. Dunlap, secretary of the American Society of Civil Engineers, who was seriously injured in a train wreck near Buda, Ill., June 30, died July 29 at the Presbyterian Hospital, Chicago, where he had been taken immediately after the accident. Charles F. Loweth, past president of the society, accompanied the body to Franklin, Vt., where funeral services will be held today July 31.

Mr. Dunlap had been secretary of the Am. Soc. C. E. for two years, having been elected during the annual meeting at Portsmouth, N. H., in the latter part of June, 1922. He succeeded to the office left vacant by Dr. Charles Warren Hunt in 1920 and filled since that time by Herbert S. Crocker and Elbert M. Chandler, with the title of acting secretary. Mr. Dunlap left the position of professor of hydraulics and sanitary engineering at the State University of Iowa, Iowa City, to accept the secretaryship of the Am. Soc. C. E. In addition to his university work he had devoted part of his time to the practice of civil and sanitary engineering.

Mr. Dunlap was born at Harrisville, N. H., Sept. 9, 1882. He was graduated from the Thayer School of civil engineering of Dartmouth College in 1908 after receiving his A.B. degree at that institution in 1905. For a short period during 1905-1906 he served as chainman and levelman in Nevada on the Truckee-Carson project of the U. S. Reclamation Service, returning to college to continue his engineering studies. During the summer of 1907 he joined the engineering corps of the Indianapolis division of the Pennsylvania R.R., with headquarters at Columbus, Ohio, and the following year served as field instructor in surveying at the Thayer School.

After graduation he joined the faculty of the State University of Iowa as instructor in descriptive geometry and was promoted until he became professor of hydraulics and sanitary engineering in the college of applied science at that institution. He filled a summer engagement in 1914 with the extension division of the university and from 1915 to 1922 had done consulting work.

Complaint Made Silt in Barge Canal Restricts Business

That the limit placed on the draft of vessels operating through the New York State Barge Canal by its silted condition represents the difference between profitable and unprofitable operation was the gist of the complaints made to the commissioner of canals by members of the Canal Operators Association at a conference held in New York on July 29. The safe draft as given by the commissioner to the insurance companies this season is 9½ ft. The depth of water is supposed to be 12 ft. Operators are anxious to have the canal dredged to its full depth as soon as possible and in the mean time are pressing to have the prescribed safe draft increased as some narrow bottom vessels have been run through the canal at a draft of as much as 10 ft. 3 in. Even at this draft they cannot carry some business profitably.

Outside of a few bars the condition of the channel was stated to be fair. Numerous groundings which have been reported as having occurred in the channel were found, upon examination, to have been due to vessels getting out of the channel. Part of this was due to buoy lights having been put out of commission by boys shooting at the lenses. A representative of the state engineer was present and outlined the work being done to improve the channel. Contracts have been let for over 757,000 cu.yd. of dredging and already 270,000 cu.yd. have been removed although work did not start until July 1. Contracts for placing 117,000 cu.yd. of bank protection have also been let. It is estimated that this material will prevent 150,000 cu.yd. of silt from entering the canal next spring.

Compromise Plan Ends Long Deadlock Over Toronto Viaduct

The eleven-year conflict over the details of the grade-separation plan for the waterfront at Toronto, Ont., has at last ended in an agreement based on a plan suggested by Col. DuBuc, chief engineer of the Canadian Department of Railways and Canals. This plan is a modification of the one to which all the parties concerned, i.e., the Toronto Harbor Commission, the city council, the Canadian Pacific and the Canadian Northern Ry., committed themselves in 1913. The war stopped work on the plan but the new union station, now standing idle, was built to suit the track elevation in its neighborhood.

In the compromise plan certain streets are closed and other economies made so that the cost has been reduced from over $34,600,000 to about $28,500,000. Of this amount the Toronto Harbor Commission will contribute about $9,000,000 and the C. P. R. and the C. N. R. the balance in equal amounts.

The enabling bill which has been passed by the Canadian Parliament provides that the new agreement shall be signed within four months from July, and that construction shall begin immediately thereafter.

California May Increase Gas Tax to Three Cents

Practically unanimous sentiment in favor of increasing the California state gasoline tax to three cents a gallon to finance future road work has been found by Governor Richardson's special committee investigating the California State Highway System. In every county visited the committee has found opposition to additional bond issues for road purposes. The committee, it is said, will recommend against the bond issue system of financing highway work.

The plan under consideration contemplates that the entire proceeds of the additional cent gasoline tax shall go to the state for new construction purposes, the other two cents being split between state and counties as at present for maintenance purposes.

The additional cent and possible doubling of the flat $3 license fee is expected to raise $10,000,000 annually for construction purposes.

Andrew A. Cohill

Best known as chief engineer for Patrick McGovern & Co. on construction of the 60th St. tunnel of the New York City subway system and also on the building of the Boston Army Supply Base, Andrew A. Cohill died July 2 of pneumonia at St. Vincent's Hospital in New York, where he had been removed from the Commodore Hotel. Mr. Cohill had more recently been general manager of Abbott-Merkt & Co., of New York, as noted in these columns July 10, p. 79.

Forty-Six-Year Old Iron Bridge Fails Under Overload

On June 19 one span of an old iron bridge across Swatara Creek near Jonestown, Lebanon County, Pa., collapsed under a motor truck weighing about 12 tons. The bridge had for some time been posted as having a capacity of 3 tons, but the driver of the truck ignored this warning.

According to James B. Long, consulting engineer of Norristown, the collapsed span formed half of a two-span bridge erected in 1878. The span was 106 ft. and the roadway width 16 ft. The truss was of bowstring form, and had a top chord consisting of a single 9-in. I-beam bent to approximate elliptical shape and a bottom chord of two bars 4 x ⅞ in. The chords were connected by very light cast-iron verticals spaced 6 to 8 ft. apart, with 1-in. diagonal in each panel. The floorbeams were 5 x 12-in. timbers resting on the bottom chord, spaced 2 ft. on centers. At intervals of about 14 ft. braces extended from the top chord to the floorbeams, to which they were bolted; these braces formed the only means of keeping the trusses in alignment. A number of other bridges of the same type are still in service in Lebanon County.

California State Bridge Program Extensive

Highway Commission Approves Contracts for 55 Structures To Cost Total of $2,000,000

During the first five months of this year the California Highway Commission has approved for contract 55 bridge jobs to cost a total of approximately $2,000,000. In the same period plans have also been approved for the construction of 26 government and county bridges on the state highways at an estimated cost of $1,000,000. A number of the latter will be constructed jointly by the state highway commission and the counties.

A total of 244 bridges is still needed to close gaps in state highways which have already been completed or are now under way, but this figure does not include all the bridges necessary to complete the state highway system. Of the number mentioned, 42 are to be built by counties and 202 by the state, the latter at an approximate cost of more than $8,000,000. A few of these structures are already under construction and other are being advertised for contract; the remainder are expected to be erected when funds are available.

Since the latter part of 1923, the construction as well as the design of all bridges on state highways has been under the supervision of the bridge department of the highway commission, this being a departure from the previous plan of putting responsibility for construction on the division office in whose territory the bridge work happened to be.

To take care of the increased work and responsibility attendant upon this change in policy the bridge department's staff has been enlarged and now includes forty engineers and designers. It is expected that the new policy of centralized authority will result in improved and more economical designs, more uniform construction, and more expeditious erection, in addition to building up a corps of trained and experienced engineers and inspectors.

R. M. Morton is chief engineer of the California Highway Commission and Harlan D. Miller is acting bridge engineer.

Foundation Co. Gets Contracts

Contract has just been signed by the Foundation Co. whereby it will build for the Hudson Valley Coke and Products Corporation a byproduct coke plant near Troy, N. Y., which will include an auxiliary water-gas plant for the supply of six Hudson Valley cities. The total cost of construction will be about $2,500,000. In connection with this contract, the Burden iron furnace near Troy is to be modernized under the supervision of The Foundation Co. at a cost of about $1,000,000. This construction company has also been awarded a contract by the Adirondack Power & Light Corporation to lay 17 miles of 12-in. pipeline to carry gas under high pressure from the gas plant near Troy to the City of Schenectady. This will involve an expenditure of about $350,000.

Progress Made on Union Station at Cleveland

This Year's Construction Program Calls For Expenditure on Preliminaries of About $10,000,000

Material progress on the preliminary construction work of the new Union Station at Cleveland, Ohio, is to be made this year, the program calling for the expenditure of about $10,000,000 this season for excavation, bridges and retaining walls. Most of the buildings in the station area adjacent to the Public Square have been wrecked and extensive excavation is in progress in this area south of the Public Square, as well as on the west approach about four miles from the station. On this approach, construction of a bridge is under way to carry West 25th St. over the railway right-of-way. The bridge will be about 230 ft. long and 82 ft. wide, spanning eight main-line and rapid-transit tracks. This crossing will involve the construction of about 800 ft. of sewer, the removal of about 75,000 yd. of earth and the placing of about 6,000 yd. of concrete and 1,300,000 lb. of steel.

During the present year excavation work in the station area will be continued and new work opened up; retaining walls will be started in this zone while at the west approach grading work will continue and additional highway bridges will be constructed.

Preparations are under way for constructing a retaining wall along Ontario St., south of the Public Square. This wall will be about 500 ft. long and 20 ft. high; the contract will call for approximately 225,000 yd. of excavation; 240,000 lb. of steel sheetpiling and placing 6,000 yd. of concrete and 800,000 lb. of reinforcing bars. Contractors to whom work is already let are the Richley Construction Co., Gest & Co. and the Walsh Construction Co. This great terminal project, described in *Engineering News-Record*, Dec. 22, 1921, page 1020, is being carried out by the Cleveland Union Terminals Co.

Mathematical Congress to Be Held at Toronto

An international mathematical congress will be held in Toronto, Canada, August 11 to 16, 1924, under the auspices of the University of Toronto and the Royal Canadian Institute and will be conducted in conformity with the regulations of the International Research Council. Special prominence will be given to the engineering and other practical applications of mathematics and contributions have been invited from mathematical physicists and engineers engaged in mathematical investigations.

This is the first meeting of the congress to be held on the American continent. Seventy scientific institutions in America and ninety in Europe and elsewhere have arranged to send delegates. Information regarding the congress may be obtained from Professor J. K. Synge, Royal Canadian Institute, Toronto, Canada.

Reclamation Scheme Proposed for China Famine Relief

As part of its scheme for the relief of famine sufferers the China International Famine Relief Commission proposes undertaking the construction of the headworks for the Wei Peh Irrigation project of the Shensi Conservancy Board on the King River in the Province of Shensi. There is at present an irrigation canal on the King River which supplies a limited amount of water to about 6,000 acres of land. The new project includes a diversion dam and a tunnel 2,300 ft. long. It will supply water to 200,000 acres at first and can be enlarged to supply 700,000 acres. The estimated cost of the work is from $1,500,000 to $1,750,000, Chinese currency, or about $800,000 in U. S. currency.

Moffat Tunnel Headings Make Good Progress

A report of the Moffat Tunnel Commission, made public on July 17, states that to date there have been completed 7,095 ft. of the water tunnel, and 5,007 ft. of the railroad tunnel headings, and that 1,162 ft. of the railroad tunnel has been completed. Driving the headings has cost only $10.36 per cu.yd. as compared with the estimated cost of $17. The percentages of work done to the total to be done are: water tunnel, 22 per cent; main tunnel headings, 16 per cent; cross-cut, 27 per cent; finished railroad tunnel, 4 per cent. On this basis the progress to date is within the estimated time necessary to complete the tunnel according to the contract, and the president of the tunnel commission states that he sees no reason why it should not be completed on or before Aug. 1, 1926, at a saving in time under the contract of from eight to ten months.

Second Derrick Failure in Month in New York City

On July 28 failure of the fall line in a wooden-mast derrick let fall a load of about six tons of structural steel being placed in the erection of a steel frame structure at 254 West 35th St., New York City. The report of the inspector from the Manhattan Bureau of Buildings was to the effect that the fault was entirely that of the donkey-engine driver, who, with a sudden clutch application, threw too great a strain in the cable and it parted. The boom with its load fell, the steel crashing 12 stories through the temporary sidewalk in front of the building. No one was seriously injured, though two laborers employed by the contractor, the Charles R. Hedden Co., suffered slight injuries.

This was the second accident of the kind in New York City within a month, On June 25 the mast of a derrick of the same sort, with timber mast and boom, snapped about 4 ft. below the top of the mast, sending a heavy load of steel members through five stories of a brick hotel on Seventh Ave. The cause of that accident was given by the building department as overstrain of the mast due to too short anchorage.

Southern to Build Large Yard

A contract for the design and construction of the John Sevier yard, near Knoxville, Tenn., has been awarded to the Foundation Co. by the Southern Railway Co. The new yard will be a gravity freight classification yard about three miles long and having a capacity of 2,929 cars, and laid out for future extensions. A total of 51 miles of standard-gage track will be laid at the present time. The contract covers the construction of the yard, a 34-stall roundhouse, machine shop and power house, cinder pits, turntable, freight transfer shed, stock pens, track scales, dwellings, water supply and fire protection, signal system bridges and culverts. A temporary camp to take care of 400 men is being established, and actual construction will begin shortly.

Montreal Bridge Plans Submitted

Construction work on the new South Shore Bridge between Montreal and the south shore of the St. Lawrence will probably be commenced late this autumn and completed in about two and one-half years, according to W. L. McDougald, president of the Montreal Harbor Commission, under whose direction the bridge will be built.

Designs for the bridge were submitted by Monsarrat and Pratley, consulting engineers, Montreal, and by Joseph B. Strauss of Chicago, acting in conjunction with Frederick W. Cowie, consulting engineer of the Montreal Harbor Commission. The latter then engaged Leon S. Moisseiff of New York, to investigate and submit an independent technical judgment on the competitive designs and plans and estimates received by them. Mr. Moisseiff's report, together with the contents of the two competitive schemes, has now been lodged with the Federal Department of Marine and Fisheries.

Building Contractor Sues Union

What is believed to be the first suit entered by a building contractor against labor unions has been filed with the Essex Circuit Court by the Clifford F. McEvoy Co. of Newark, N. J. The defendants named in the suit include fifteen building trades labor leaders, eleven building trades union locals, the Carpenters' and Joiners' District Council and the Building Trades Council of Newark.

The suit is an outgrowth, the bill of complaint shows, of the tie-up of work on the Georke building in Newark, which the McEvoy company had been constructing with an all-union force until the unions halted operations in an effort to compel the establishment of union wage scales on the Wanaque water supply development work, also handled by the same company. The suit calls for damages to the amount of $500,000.

The suit is simply one for damages alleged to have grown out of the action of the defendants, holding no request for an injunction or other action of that nature, but asking for what the highest courts have held to be the right of the employer to "full redress" for business injuries.

Two Power Projects Licensed

A license to develop 5,400 hp. on the Kawishiwi River in northern Minnesota has been issued to the Minnesota Power & Light Co. by the Federal Power Commission. The issuing of a federal instead of a state license became necessary when the Chief of Engineers ruled that the Kawishiwi is a navigable stream. A license has also been authorized for the Columbus Electric & Power Co., covering a site on the Chattahoochee River at Bartlett's Ferry, 18 miles above Columbus, Ga.

East Bay Cities Looking for New Water Supply

As the result of a protest from the East Bay Municipal Utilities District against the granting of a preliminary power permit to Stephen E. Kieffer, covering a proposed development on the Cosumnes River in Amador and El Dorado Counties in California, the Federal Power Commission has withheld action on the Kieffer application. Mr. Kieffer proposes diverting the water of the Cosumnes River to the Arroyo Seco on Dry Creek near Ione.

The action of the East Bay cities indicates that they are considering the Cosumnes River as a possible source of water supply. Heretofore, they have been considering sites on the Eel River, on Trinity River at the Iron Canyon Dam, on the Sacramento, on the Mokelumne and at Hetch Hetchy.

Reorganized Pan-American Railway Committee Meets

The first meeting of the reorganized railway committee of the Pan-American Union was held in Washington on July 7. As at present constituted the committee is made up of the following: Juan Briano, of Argentina; Tobias Moscoso, of Brazil; Santiago Marin Vicuna, of Chile; Francisco P. de Hoyos, of Mexico; and Charles M. Pepper, Verne L. Havens, and Minor C. Keith, of the United States. The first meeting was attended by Messrs. Vicuna, Hoyos, Pepper and Dr. L. S. Rowe, director-general of the Pan-American Union.

The committee approved a resolution requesting the Pan-American Union to obtain all the available information from the governments of Latin America relative to railways in their respective countries, this information to be made the basis of a report of the committee at a meeting to be held in 1925, possibly at Buenos Aires, Argentina. The reorganized committee will consider, among other things, a revision of the railway route between New York City and Buenos Aires recommended in the original report of the Intercontinental Railway Commission, created by the first international conference of American States. The report of the Intercontinental Commission favored the construction of a line which would traverse the western highlands of South America until it reached southern Peru, but opinion now seems to favor the construction of a line passing east of the Andes and avoiding the mountainous regions.

Quebec Harbor Work Financed

A total of $500,000, an amount sufficient to allow all the work that could be carried out this year to be accomplished, has been given to the Quebec harbor commissioners by the federal government of Canada. The contemplated improvements to the harbor involve an expenditure of $10,000,000, and it is understood that the federal government has agreed to the proposed plans, but the loan is to be spread over a number of years.

Pennsylvania R.R. to Build Bayard-Canton Cutoff

The Pennsylvania R.R. Co. has announced that it has applied to the Interstate Commerce Commission for permission to construct the cutoff between Bayard and Canton, Ohio, and that the U. S. Government has approved the plans for the new Beaver River bridge, and for the rebuilding of the Steubenville bridge. At the latter bridge three new spans will take the place of the present five spans; the center span will be 544 ft. long, and the two flanking spans 340 ft. long. The clearance above low water will be 90 ft.

The cutoff between Bayard and Canton is part of the improvement of the Cleveland-Pittsburgh lines described in *Engineering News-Record* July 17, 1924. p. 88. The total cost of the new work will be about $9,000,000, and will include two new tracks at New Brighton for the approaches to the Beaver Ridge bridge.

Ask Authority to Construct 142 Miles of Railway

The Owensboro, Rockport & Chicago Ry. Co., of Owensboro, Ky., has applied to the Interstate Commerce Commission for authority to construct a railroad line with Owensboro, Ky., as its southern terminus, to extend through Rockport, Ind., to Elnora in Davies Co., Ind., a distance of 84 miles. The company also asked for authority to construct a bridge over the Ohio River between Rockport and Owensboro as provided for in Act of Congress approved April 17, 1924.

The St. Louis, Brownsville & Mexico Ry. Co., of Houston, Tex., has applied to the Interstate Commerce Commission for authority to construct an extension of its road a distance of 28 miles from Lyford to Edinburgh, Tex. The purpose of the extension is to afford a shorter and more convenient haul for agricultural products and for substantial economies in operation through the relief of congestion on the Hidalgo branch. The St. Louis, Brownsville & Mexico Ry. is a part of the Gulf Coast Lines.

The San Benito & Rio Grande Valley Ry. Co., Houston, Tex., has applied for authority to construct a 30-mile extension of its main track from Santa Maria to Monte Christo, Tex. The purpose of this extension is to afford transportation facilities to territory which will be cut off by the construction of a floodway recently authorized.

Random Lines

Explaining Road Reinforcement

In discussing a new concrete road, an old lady who had been watching the construction said, "Now I know why the concrete pavements are so easy to ride on. This morning I watched them lay the bed springs in the concrete."

—*Contractor's Atlas.*

After reading several explanations of the theory of reinforcement in concrete roads and the methods of its design we have concluded that the old lady is about as close to the truth as anyone.

* * *

Both Frank and Versatile

YOUNG man, good habits, wants position, engineer's office, trained in grafting, blue prints and surveying. Mel. 3869

Facsimile of an advertisement in a metropolitan daily

* * *

Technical Literature as She Is Writ

The following reproduces *verbatim et literatim* a contribution recently received for publication:

The Towering Precipices and cliffs along Dix River, where formerly Silence reigned Supreme and the stillness was broken only by the cries of the Wild things that were monarchs of all they surveyed, are disappering under mans modern attack, although they withstood the savage unslaughts of the elements for untold centuries.

Today the hum of machinery is heard where once the warhoop of the redskins rent the air, and terrific intonations of high power dynimate blasts shake the earth where once the crack of the Pioneers rifle proved the requim for some blood thirsty savage or sustenance for the hunters family.

The greatest engineering feat over attempted in the Middle West is in progress here and hundreds of workmen are employed day and night to complete the largest and highest power dam west of the Rockey Mountains. On the topmost Pinnacle a highway will be built, therby making the adjacent countryside available to traffic.

Falling water from monster pipes behind the dam will connect with blades of modern Turbane engines and each will have power enough to drive an electril generator.

* * *

HYBROW ENGINEER —The young man we want is an engineering graduate, between 25 and 30 years old, capable of intelligently handling important service correspondence for a rapidly growing manufacturer of automotive equipment. Must be ambitious and a hustler.—Ad in Minneapolis *Journal*.

* * *

The Funny Men Are Taking It Up

Slippery Dell Nanlon, Piggly Wiggly bandit, "possum player," Pullman car fugitive, *jail break engineer* and Canon City life termer, is in the limelight again today.—Denver *Times*.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF SANITARY ENGINEERING, New York; Annual Convention, Philadelphia, Pa., Sept. 9-12, 1924.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Meeting, Rochester, N. Y.; Sept. 30 to Oct. 3.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburgh, Fla.; Annual Convention, Boston, Mass., Sept. 29-Oct. 3, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, Detroit, Oct. 23-25, 1924.

The Texas Association of Sanitarians will hold at Houston, Tex., Nov. 4 to 16 its meeting for the annual school for sanitarians conducted in co-operation with the Texas State Board of Health.

The American Ceramic Society announces its summer meeting to be held Oct. 6 and 7 at the Hotel Biltmore, Los Angeles, Calif. Further information may be obtained from Fred B. Ortman, chairman of the summer meeting, Tropico Potteries, Inc., Glendale, Calif., or Lord Hall, general secretary, Ohio State University, Columbus, Ohio.

The North Carolina Section of the American Society of Civil Engineers will hold its first annual convention Aug. 11-13 at Kenilworth Inn, Asheville, N. C., with papers on engineering education, city surveys, the development of the Catawba River, and the construction of high-tension transmission lines, by Dr. G. M. Braune, Frank T. Miller, A. C. Lee, and H. V. Joslin, respectively. Thorndike Saville is secretary of the section.

Personal Notes

R. C. WHITE, heretofore general superintendent of the Eastern District, Missouri Pacific Railroad Co., has been appointed engineer, maintenance-of-way, with headquarters at St. Louis, Mo.

MAJ. GEN. GEORGE W. GOETHALS has been retained by Los Angeles County, California, to pass upon plans for dams and other works to be built under the $35,300,000 bond issue recently approved for flood protection and water conservation measures in Los Angeles county.

BRIG. GEN. EDGAR JADWIN, Assistant Chief of Engineers, is making an inspection trip in the Great Lakes region where he is familiarizing himself with the status of harbor and channel work.

E. H. HARROUN, hydraulic engineer, has been appointed by the California State Railroad Commission as an advisory engineer in water matters to assist in the commission's effort to provide relief, where possible, to water consumers who are subjected to inconvenience or threatened with loss due to the prevailing drought conditions in the state. Mr. Harroun's services will be as arbiter between water consumers and local public utility water companies, and he will advise the latter in developing their resources fully.

R. E. CALDWELL, state engineer of Utah for the last three years, has resigned to give full time to his private consulting practice with the firm of Caldwell & Richards. Lloyd Garrison, deputy state engineer, has been appointed to fill out Mr. Caldwell's term. No new deputy will be appointed.

JOHN C. SHERIDAN, JR., Hempstead, Long Island, New York, has been elected vice-president of Charles Meads & Co., engineers and contractors, New York City.

H. B. MUCKLESTON, who recently opened an office as consulting engineer at 901 Rogers Building, Vancouver, B. C., and was previously chief engineer of the Lethbridge Northern Irrigation District, in Alberta, announces his affiliation with Dr. J. A. L. Waddell for the design and supervision of construction of bridges in Alberta and British Columbia. Under the arrangement, Dr. Waddell will make the economic studies, estimates and layouts and will prepare the complete drawings and specifications for such bridge work as is undertaken, and Mr. Muckleston will inspect and supervise construction for the client.

A. A. PORTER, formerly superintendent on construction work for the Hagedorn Construction Co., has been appointed general inspector of construction of concrete and other structures for the city of Winston-Salem, N. C.

COL. GEORGE B. PILLSBURY, a member of the engineering board appointed to study the St. Lawrence project in connection with the Hoover committee, is making a trip along the St. Lawrence and is conferring with the Canadian engineers. Attendance at the General Staff School prevented Col. Pillsbury from making the trip with Secretary Hoover's party. He now is familiarizing himself with the latest developments in connection with the new study being made of the St. Lawrence and the borings which are in progress on the Canadian side. Col. Pillsbury has been placed in charge of the Great Lakes survey, in connection with which the work on the St. Lawrence will be conducted.

A. KEMPKEY, San Francisco consulting engineer, has been appointed chief engineer for the Gordon Valley water project for the city of Vallejo, Calif. Mr. Kempkey succeeds C. E. Grunsky, of San Francisco, who resigned. Mr. Kempkey is a graduate of the University of California and has practiced civil engineering for the past twenty-two years. Among the projects with which he was associated are the remodeling of the distributing system of the Victoria, B. C., municipal waterworks; he has also served as consulting engineer of the San Pablo Dam of the East Bay Water Co. in Alameda County, Calif., and in a consulting capacity for the Balfour-Guthrie Co. in the Brentwood irrigation project in California, and for the San Joaquin River Water Co.

F. A. MERRILL, formerly engineer of maintenance-of-way, Boston & Maine R.R., has been appointed chief engineer to succeed Arthur B. Corthell, deceased. Mr. Merrill will continue to act as engineer of maintenance-of-way, the two departments having been combined.

Obituary

CHARLES STILLMAN SPERRY, professor of engineering mathematics at the University of Colorado for several years and until he was forced to relinquish his position because of ill health, died July 10 of tuberculosis.

STANLEY R. ALEXANDER, who served as harbor engineer at Baltimore, Md., from 1912 to 1918, died July 16 at his home in Baltimore. Before becoming harbor engineer, Mr. Alexander was bridge designer for the city highways department.

ALVIN E. DEAL, Hoboken, N. J., bridge engineer of the Delaware, Lackawanna & Western Railroad Co., died July 24 at the Flower Hospital, New York City, of acute septic poisoning, aged 64 years. Mr. Deal was born in Green Island, N. Y., and graduated in 1882 in civil engineering from Rensselaer Polytechnic Institute. After spending three years in various engineering works and one year with a bridge company at Pittsburgh, Pa., he accepted a position as assistant engineer in the engineering department of the Lackawanna. In 1903, Lincoln Bush, at that time bridge engineer, was made chief engineer, and Mr. Deal was made bridge engineer in his place, which position he had held ever since. Mr. Deal during his period as bridge engineer looked out for future development as well as present, and did not allow expediency to militate against following the broadest possible policy. His insistence upon having bridges under consideration designed to take care of future increase in locomotive loading has been amply justified, as bridges which he built thirty years ago are satisfactorily carrying the heavy loads of today.

WALLACE DOWNEY, president of the Downey Shipbuilding Corporation, of Mariner's Harbor, Staten Island, N. Y., died suddenly July 23 at Montclair, N. J. Mr. Downey was born in Nova Scotia but came to New York in his youth. He was for a time in the employ of the Townsend Co., working at the Erie dry dock. In 1898 he went into business for himself, founding the Downey dry dock at Shooter's Island, near Staten Island. The company which he formed at that time was very active during the World War in ship construction for the United States.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Electric Locomotives for Construction Work

By H. H. Johnston

General Engineering Department, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

INCLUDED among the changes in equipment for construction work in the past few years is the use of electric locomotives for hauling rock, sand, timber, fuel and other materials used for or taken from tunnels, underground trafficways, waterways, dams and open cuts. In the case of industries other than construction the installation of electrical equipment and haulageways is more or less permanent, but in construction there is required a moving about of operations from one locality to another, with a consequent shifting

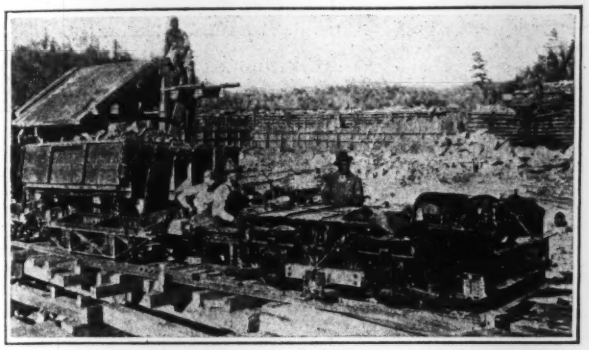


FIG. 1—THIRD RAIL FOR TRACK THAT MUST BE SHIFTED OR EXTENDED

of tracks and other equipment. To secure the flexibility made necessary by this condition proper consideration must be given to the type of locomotive, power distribution over the haulageways, trolley construction and third-rail construction.

For some classes of construction the overhead trolley is best adapted; for others, the third-rail construction, and for still others, both trolley and third rail. In Fig. 1 is shown a third-rail construction which has been found useful where the tracks are shifted or extended as the construction work progresses. Fig. 2 shows the details of the third-rail construction used by the Dixie Construction Co. with simple and effective means for protecting the power rail. The special Z-bars are fastened to the ties every 10 ft. To the top and side of the Z-bars boards are bolted which, with another board fastened to angle irons at the front, protect the power rails effectively on three sides.

Collection of Current—In the majority of cases 250-volt trolley voltage is used with a grounded return system. The current is collected from the wire, usually by a wheel type of trolley with pole. If the third-rail construction is used either a gravity type or an overrunning type of contact shoe collects the current. When a trolley is used the general location of the trolley wire can shift considerably with respect to the tracks without interfering with the collecting of the current, but with the third rail the relationship of the power rail to the running rails must be uniform. In Fig. 1 the power rail is supported on the same cross ties as the main running rails, as is also the case with the supports or Z sections for the power rail guards. The overrunning type of contact shoe is shown in Fig. 1 and the shoe is mounted on a third rail shoe beam which is, in turn, bolted to the locomotive side frame.

In construction work it is not essential that as the work progresses the trolley or third rail be put in place at the same time as the main rails. By means of an electric motor-driven gathering reel on the locomotive, the locomotive can operate beyond the end of the trolley or third rail for distances of as much as 600 ft. This reel carries on its drum 500 to 600 ft. of single conductor flexible cable with a hook at the end for connecting to the overhead trolley wire or the power rail. The reel is designed to keep the cable taut at all times, thus preventing more than the required amount of cable

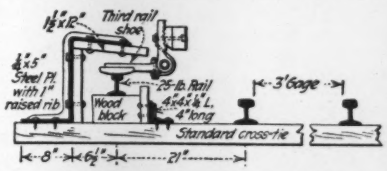


FIG. 2—POWER RAIL PROTECTOR BY Z-BARS AT MITCHELL DAM

from being off the reel at any time. As the locomotive moves toward the end of the trolley or power rail the cable is automatically drawn in and spooled evenly on the drum of the reel.

On construction work the advantages of the electric locomotive include speed, ease in starting with loads, absence of reciprocating driving units, and smooth riding qualities. The absence of standby losses and troubles from impure water,

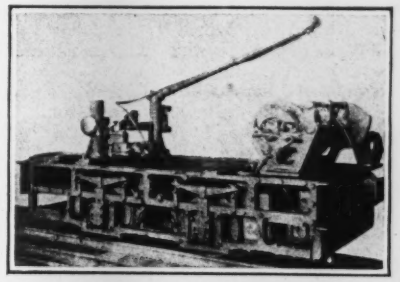


FIG. 3—FOUR-TON TROLLEY LOCOMOTIVE WITH GATHERING REEL, NIAGARA FALLS

no leaky flues or fire hazard are other advantages. A considerable saving is effected by eliminating the cost of handling fuel up to the locomotive. No fireman is required and delays from failure to maintain full steam pressure are eliminated. With electricity available electric locomotives require no power while not actually working and do not need the attention of a hostler to look after the fires under the boilers when the locomotives are not actually in use—for example, between shifts on construction work.

Typical Installations

Among the most interesting large-scale electric haulage installations are those of (1) the Dixie Construction Co. work at the Mitchell Dam for the Alabama Power Co.; (2) the Niagara Falls Power Co.'s underground waterway at Niagara Falls, N. Y.; (3) the Booth & Flinn Co. work on the twin traffic tunnels, Pittsburgh; (4) the Southern California Edison Co. work on the Big Creek No. 3 power plant waterway; and (5) the Booth & Flinn Co. work on the Hudson River vehicular tunnel, New York.

Mitchell Dam—When the Dixie company started building the Mitchell dam it was recognized that, if the work was to be completed on schedule time, the company railroad from Coopers to the dam would have all the traffic it could bear in delivering the cement and supplies required without the added burden of hauling coal. This, together with the considerable saving in cost by the use of electricity, determined the policy of the company in favor of electric machinery wherever possible.

Seven electric locomotives were purchased for the work at the Mitchell dam; they are of the Westinghouse-Baldwin type of the 8-ton, 36-in. gage class, equipped with four 30-in. steel-tired wheels. The locomotives are fitted with steel shoes for operation by means of a third rail placed about 21 in. outside of the running track. In addition to the steel contact shoes, each locomotive is equipped with a cable reel on which is wound 300 ft. of flexible electric cable. By making contact between this cable and the power rails the locomotive can be operated some distance away from the power rails.

The current used for operating the plant railroad is 250 volt d.c. The transmission line from the Alabama Power Co. lock No. 12 to the dam is for 44,000 volts, and at the dam this current is transformed to 2,300 volts.

By means of a motor-generator set it is then transformed from 2,300 volts a.c. to 250 volts d.c. The motor-generator set is in the compressor house where one man operates three air compressors and the motor generator. On this work the first locomotive was placed in service Nov. 12, 1921, and the others shortly afterward. Since that time they have all been in continuous service, much of the time on both night and day shifts.

Niagara Falls—In Fig. 3 is illustrated the type of locomotive used by the Niagara Falls Power Co. on its 4,000-ft. waterway tunnel, with a section 26 ft. wide and 36 ft. high.

Work is divided into shifts of 10 hours each per day, during which the locomotives are in service handling 150 cars of material per shift. At the end excavations the locomotives are required to operate on grades as high as 6 per cent.

The details of construction of the locomotives used at the Niagara tunnel

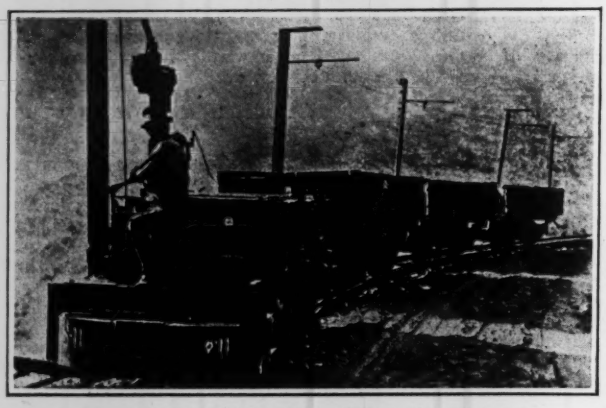


FIG. 4—EIGHT-TON LOCOMOTIVE OF TROLLEY-BATTERY TYPE

are illustrated in Fig. 3. The trolley pole sockets are mounted above the locomotive side frame. Current is collected from an overhead trolley which varies in height above the rails between 8 and 10 ft. The locomotives are equipped with a gathering reel to permit running past the overhead trolley wire for a distance of 500 ft. The use of this reel permits a degree of flexibility desirable in construction work and permits a reasonable lag of time in getting the overhead construction in place as the tunnel is driven and the main tracks are laid. On these locomotives the gathering reel is mounted above the side frames of the locomotive high enough to permit it to be turned through an angle of 180 deg. on a swivel base. This arrangement prevents loss of time in turning around, which would otherwise be necessary since no facilities such as are provided for turning the locomotive on a turntable or a track loop are provided.

Liberty Tunnels—Another application of electric locomotives to construction work was for the recently completed twin traffic tubes of the Liberty Tunnel at Pittsburgh, driven through rock for a distance of over a mile. Separate power plants at each end were installed and the power for the haulageways was delivered at 250 volts by overhead trolley and ground rail return. The trolley wires and the rails were laid as fast as the material was cleared away both on the bottoms and roofs of the tunnels. The running rails were always kept close to the workings, while the overhead trolley construction was permitted intentionally to lag for distances of 500 to 600 ft. This was made possible by the use of horizontal electric cable reels on the locomotive.

Vehicular Tunnel—For the construction of the Hudson River vehicular tunnels which will link New York to New Jersey, Booth & Flinn, Ltd., operate sixteen 5-ton trolley and third rail locomotives for handling the material excavated from the tubes. Each of the twin tubes is 29 ft. 6 in. in diameter and 9,250 ft. long.

Battery Trolley Locomotives — Construction now under way for the Southern California Edison Co. makes use of fourteen 8-ton locomotives of the combination trolley and battery type. In addition there are six Westinghouse-Baldwin 6-ton locomotives. All the locomotives are being operated as combination battery-trolley machines. Each carries a 110-cell, 17-plate Hobbs storage battery from which it operates when pulling muck cars from the steam shovel at the tunnel heading to the permanent trolleys, which cannot be brought nearer than 300 to 500 ft. from the heading. Up to 500 ft. from the headings, however, the locomotives operate from a permanent overhead trolley which runs out to the dump. The trolley voltage is approximately 268.

During operation on the trolley the storage battery floats on the line or takes a charge if the battery voltage happens to be below the trolley voltage. The battery crates are all equipped with a Sangamo ampere hour meter, and Sangamo circuit breaker. It is not necessary to take a battery into the charging station for charge, for under normal conditions it receives its complete charge from a trolley when the locomotive is not in operation. The only time the battery is called upon to furnish all the power for the locomotive is while hauling the cars to and from the shovels to the permanent overhead trolley. If it is desired to give the batteries a further discharge the locomotives are operated for a time with the trolley pole down. Occasionally a battery is found almost completely discharged and in this case it is taken to a charging station and given a slow charge until the voltage is brought up sufficiently to make it again safe to charge from the trolley.

At present two locomotives operating on a 56-lb. rail and 36-in. gage track are used at each tunnel heading on the No. 3 project. The tunnel is 21 x 21 ft. and the average progress per day is 12 ft. With each foot of progress 19 yd. of muck is produced, making a total of 288 yd. of muck taken from each heading by two locomotives each day. One yard of loose muck weighs approximately 1½ tons, making a total of 342 tons of muck per day per heading. The distance which this muck is hauled varies according to the distance in of each heading, ranging from 1,000 to 5,000 ft. Seven headings are being operated on the No. 3 project. Each locomotive pulls two 9-yd. cars from the upgrade heading with an average grade of 0.003 per cent. The maximum grade on some of the dumps, however, runs as high as 2 per cent for short distances. Since the locomotives have been in service no trouble has been experienced with them either mechanically or electrically.

At another point the Southern California Edison Co. is using 6-ton locomotives in the construction of a 15-ft. tunnel which will be approximately 12 miles long.

Administration of American Lumber Standards Begins

The National Lumber Manufacturers Association, July 23, announced the establishment by the Association of a Lumber Standards Bureau "to promote uniformity and maintenance of grading and inspection of lumber," as authorized by the general lumber standards conference in Washington, April 23.

"The manufacturers associations have, without important exception," says the announcement, "incorporated or agreed to incorporate in their official rules and practice the standard sizes, grades, nomenclature and basic grade classifications adopted by the general conference of lumber manufacturers, distributors, and consumers approved by the United States Forest Service and recommended by the Department of Commerce. This marks progress towards national lumber standardization much beyond all reasonable expectation two years ago."

Arthur T. Upson, formerly chief of the section of industrial investigations of the United States Forest Products Laboratory, whose engagement by the National Lumber Manufacturers' Association was announced some time ago, has entered upon his new duties as lumber standards adviser to the newly established Bureau of Lumber Standards. The preparation of a handbook of standard lumber purchase specifications, approved by the Manufacturers Standardization Committee and authorized by the Central Committee on Lumber Standards, will be developed under Mr. Upson's direction. Mr. Upson's work will be greatly facilitated by the co-operation of the Division of Simplified Practice of the Department of Commerce, which will issue in the latter part of August, in its Bulletin 16, a complete copy of American Lumber Standards.

Business Notes

DR. MAXIMILIAN TOCH, vice-president of Toch Bros., New York, makers of technical paints, enamels, varnishes and waterproofing compounds, who left the United States last spring on a tour of the world, is expected to return in September. At the invitation of the Chinese Government he delivered a series of lectures at the National Institute of Technology at Peking on the technical and industrial problems of paint manufacture. In recognition of his services the institute has conferred upon him the title of Honorary Professor of Industrial Chemistry. At the present time Dr. Toch is in Austria, whence he will proceed to Switzerland, France and England before returning to New York.

UNITED STATES GYPSUM CO., Chicago, started operation July 15 of a new Sheetrock wallboard mill at Plasterco, Va.; this addition to the plant which the company has operated for many years cost $400,000 and has a daily capacity of 100,000 sq.ft. of fireproof gypsum wallboard.

UNIVERSAL CRUSHER CO., Cedar Rapids, Iowa, announces the completion of its new plant for the manufacture of crushers, pulverizers and screening and elevating machinery. This plant has more than 22,000 sq.ft. of floor space in shop and storeroom, and is equipped with new machinery and labor-saving appliances. The shop has a reinforced-concrete floor treated with a hardening process; it is provided with large windows, washroom and sanitary lockers. The offices are 50x50 ft. This company, which was organized in 1909 and took over the Eureka Rock & Ore Crusher Co. in 1915, makes stationary and portable rock and gravel crushers in 24 sizes having an output capacity ranging from a few tons to 450 tons daily.

INDUSTRIAL WORKS, Bay City, Mich., has opened a new district office at 455 Monadnock Building, San Francisco, in charge of J. M. McGuire, district sales manager.

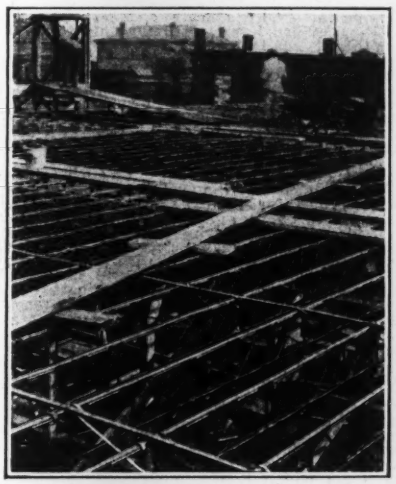
CHAUSSE OIL BURNER CO., Goshen, Ind., announces the appointment of the following sales agencies: Bakstad Machinery Co., Peoples Gas Bldg., Chicago, Ill.; W. B. Spencer, 30 Church St., New York, N. Y.; Clark-Wilcox Co., 902 Chapel St., New Haven, Conn.; Willamette Equipment Co., Portland, Ore.; Williamette Equipment Co., Tacoma, Wash.; Minneapolis Equipment Co., Minneapolis, Minn.; and W. F. Cleary Sales Agency, Indianapolis, Ind. These representatives will handle the sale of Chausse oil-burning tool and surface heaters and contractors' apparatus and salamanders in their respective territories.

CONVEYORS CORPORATION OF AMERICA, Chicago, announces the appointment of William R. Toppan as manager of its newly organized Railroad Department. The application of the steam jet ash conveyor to the handling of cinders from locomotive pits has led the company to emphasize the importance of this type of equipment in the railroad field. Previous to his connection with the Conveyors Corporation of America, Mr. Toppan was manager of the railroad department of the Graver Corporation, East Chicago, Ind.

Equipment and Materials

Light Steel Trusses for Fireproof Floor Construction

To take the place of sheet metal beams commonly used in metal lumber construction, a new type of light steel truss of specially rolled sections fabricated with a connection known as the



Rivet Grip is being manufactured by the Rivet Grip Steel Co.—formerly the Concrete Reinforcing & Engineering Co.—Cleveland, Ohio. Two of the features of these joists are, first, the elimination of all sheet metal members and, second, the use of no metal less than ¼ in. thick; as a further insurance of permanent construction no metal less than ⅜ in. thick is used at any wall bearing end.

The accompanying illustration shows the method of application of these joists to building construction. One row of double diagonal, single strap and notched angle bridging is furnished for every 6 ft. of joist length. The bridging ties the joists into a rigid working deck and eliminates the use of spacers or special beam seats. The open webs of the joists, the manufacturer points out, allow easy installation of pipes and conduits. The design of the members eliminates the use of shelf angles in steel skeleton construction.

The connections in the joists are made by the so-called Rivet Grip process, by which use is made of a 30-ton pressure to force the metal of the chord members around knobs on the web sections, securely joining these members together.

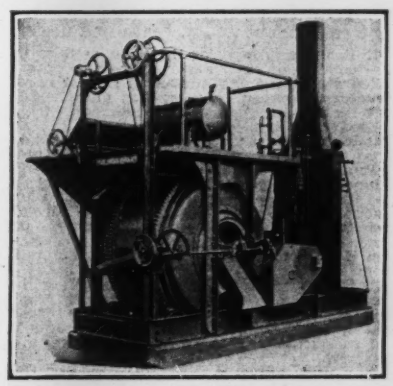
Varying with the requirements of design, the depth of the joists normally ranges from 6 to 16 in. and the spacing varies from 11½ to 23½ in. on centers. Spans up to 30 ft. are used. Where joists rest on walls, the bearing varies from 4 to 7 in. After the steel joists are placed and bridged, rib lath is placed over and wired to the top of them and concrete is poured on the lath as in other metal joist construction. Metal lath for plaster is also wired to the bottom chords of the joists.

Control 21-S Mixer from Three Operating Levels

Control from three positions—at ground level, at a point two-thirds of the height of the machine and at the top from a permanent built-in overhead platform—is the new feature which the Koehring Co., Milwaukee, has incorporated in the design of its 21-S heavy-duty construction mixer. Depending on the character of the work to be done and the location of the plant the contractor may specify any one of the three controls best adapted to his needs.

The overhead platform, which is built into the mixer when this control is specified, simplifies the operating problem when the mixer is set up in a depression, or when overhead bins are used. For the intermediate position a platform can be built around the mixer making the control point at the top of the batch hopper waist high to the operator; this intermediate platform lightens the task of handling the cement into the hopper. The ground control is used when the aggregates are discharged from an elevated bin into the batch hopper. These three control points, the manufacturer points out, make the mixer adaptable to every variety of job layout.

A cast-steel, pivoted, swinging type batch hopper gate, with an opening 11 x 20 in., has also been installed on this mixer to replace the old sliding gate. In charging the drum the new swinging type gate affords no chance for the materials to lodge or clog in the opening, thereby effecting faster charging. The materials can be charged



into the drum in 15 sec. The hopper is constructed of number 10 and 12 gage steel reinforced by heavy clip angles.

The standard power-charging skip can also be furnished if desired. The mixer is mounted either on skids or steel rim wheels. A choice of steam, gasoline or electricity is offered.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Federal Trade Commission Orders Discontinuance of Pittsburgh Plus

Order Given In Full—Effects Expected—Statements In Support Of System—Dissenting Opinion Favors Legislation

On July 21, 1924, the Federal Trade Commission issued an order that the United States Steel Corporation and its eleven subsidiaries cease and desist: "From quoting for sale or selling in the course of interstate commerce their rolled steel products known as plates, bars, structural sheets, tin plate and wire products at Pittsburgh plus prices." The vote of the Commission was four to one, Nelson B. Gaskill dissenting.

Although the decision was announced following arguments on June 23, 1924, the case dates back to 1919. It grew out of conditions complained of by more than 2,700 fabricators of steel in the Chicago, Duluth and Birmingham districts, and the formal complaint was issued by the commission upon application made by the Western Association of Rolled Steel Consumers.

The Pittsburgh plus device differs from the Pittsburgh base (price f.o.b. Pittsburgh) in that there is added to the Pittsburgh base price the freight rate on such steel from Pittsburgh, even though the steel is neither purchased at nor shipped from Pittsburgh. Thus, customers of the same will pay different prices if located at different distances from Pittsburgh.

The "Pittsburgh plus" system of pricing, which has been effective since 1903, though it is claimed that it has been violated intermittently in the last two years, can best be understood by reading the order in full, which is given as follows: It is now ordered that respondent . . . cease and desist.

1. From quoting for sale or selling in the course of interstate commerce their rolled steel products known as plates, bars, structural shapes, sheets, tin plate, wire and wire products at Pittsburgh Plus prices. (By quoting for sale or selling at Pittsburgh Plus prices is meant respondents' systematic practice of quoting and selling said products manufactured at and shipped from points outside of Pittsburgh at their f.o.b. Pittsburgh prices plus amounts equivalent to what the railroad freight charges on such products would be from Pittsburgh to each different destination if such products were actually shipped from Pittsburgh.)

2. From quoting for sale or selling in the course of interstate commerce their said rolled steel products upon any other basing point than that where the products are manufactured or from which they are shipped.

3. From selling or contracting for the sale of or invoicing such steel products in the course of interstate commerce without clearly and distinctly indicating in such sales, or upon such contracts or invoices, how much is charged for such steel products f.o.b the producing or shipping point, and how much is charged for the actual transportation of said products, if any, from such producing or shipping point to destination.

4. From discriminating in the course of interstate commerce, either directly or indirectly, in price between different purchasers of their rolled steel products known as plates, bars, structural shapes, sheets, tin plate, wire and wire products sold for use, consumption or resale within the United States or any Territory thereof or the District of Columbia or any insular possession or other place under the jurisdiction of the United States, where the effect of such discrimination may be to substantially lessen competition in any line of interstate commerce, including competition among the steel producers, or steel users, or both; provided, however, that nothing herein contained shall prevent discrimination in price between purchasers of said products on account of differences in the grade, quality or quantity of the commodity sold, or that makes only due allowance for difference in the cost of selling or transportation, or discrimination in price in the same or different communities made in good faith to meet competition. The use by respondents in the course of such interstate commerce of the system of Pittsburgh Plus prices for their said steel products, manufactured at and shipped from points outside of Pittsburgh—which prices are their f.o.b. Pittsburgh prices plus amounts equivalent to what the railroad freight charges on such products would be from Pittsburgh to each different destination if such products were actually shipped from Pittsburgh—shall be deemed to constitute a violation of this order. The use by respondents in the course of such interstate commerce of any system similar to that of the Pittsburgh Plus system shall likewise be deemed to constitute a violation of this order. The practice by respondents of selling or contracting for the sale of said products in the course of interstate commerce upon any other basing point than that where the products are manufactured or from which they are shipped, shall be deemed to constitute a violation of this order.

The majority predict that the effects of the abolition of this system will be as follows:

(a) It will build up all steel producing and consuming sections outside of Pittsburgh, which are now held back by that system. (b) Return to the Western and Southern steel users the natural advantage of the location which is taken away from them by the system. It was found that the plus system permitted the Pittsburgh competitors of the Western steel users to share the Western territory, but prevented the Western steel users from sharing the Pittsburgh territory and prevented the Western steel users for the most part from even competing east of their plants. The elimination of the system gives the Chicago steel user the same advantage in his own territory which the Pittsburgh steel users would have in the Pittsburgh territory. (c) Decentralize the steel producing industry—decentralize the other industries which use steel in the manufacture of their products. (d) Eliminate useless cross hauls by the roads of steel which now exist under the plus system, thus effecting a great saving to the public. (e) Eliminate the discriminatory prices charged by the steel producers to the consumers of the same mill. (f) Enforce price competition among the steel producers. (g) Save the farmers of the 11 Middle Western States alone $30,000,000 annually. (h) Eliminate the excessive overhead cost per unit which Western manufacturers suffer because of the various restrictions on their business due to the Pittsburgh Plus system. (i) Eliminate the necessity of the use by Eastern manufacturers of other commodities than steel in the manufacture of their products for shipment eastward. (j) Restore many Western plants which have been destroyed by the Pittsburgh Plus system. (k) Eliminate the excessive prices paid by the public for steel at all points outside of Pittsburgh, such as Chicago, Birmingham, Duluth and all other points. Under the plus system Chicago consumers pay $13.80 per ton more than Pittsburgh consumers based upon the cost of producing steel at the two respective centers. The saving to the public should amount to a great many million dollars annually. (l) Eliminate the price concealment of the discriminatory prices charged among the various customers of the Steel Corporation under the plus system and force the steel producers to disclose exactly how much they charge for steel and how much for actual freight and prevent them from charging any other freight than actual freight on their steel. (m) Eliminate the unnatural advantage of the American Bridge Co., American Steel & Wire Co. and American Sheet & Tin Plate Co. when competing with their own or the Steel Corporation's customers, who are forced to pay Pittsburgh Plus prices for their steel. (n) Eliminate the fixed Pittsburgh Plus price among the sheet manufacturers in the National Association of Sheet and Tin Plate Manufacturers with whom the respondent, American Sheet & Tin Plate Co., co-operates in price fixing activities. (o) Eliminate the Pittsburgh Plus prices in the South and force the Southern mills to sell all their products f.o.b. the mill and thus force a lower mill price at Birmingham.

In Support of Pittsburgh Plus

The arguments of the steel companies supporting the present price system are listed in Frank Emerich's treatise issued by The Associated States Opposing Pittsburgh Plus. These are:

1. It has been in existence practically throughout the life of the steel industry in America.

2. It is not of their own devising but results from the operation of an economic law—the law of supply and demand.

3. That Pittsburgh is the only district of "surplus production," and that all other steel centers, especially the Chicago district, are often unable to supply the demands made upon them.

4. That because of the working of this economic law, Pittsburgh Plus automatically disappears when supply exceeds demand.

5. That it is essential to the stabilization of the steel industry.

6. That the steel industry has been upbuilt under and because of it, this including not only the steel mill interests, but the interests of the manufacturers of articles made from steel.

7. That without the added profit obtained through the Pittsburgh Plus practice, high cost mills necessary to provide sufficient steel to meet the nation's demand in "flush" times, would be forced out of business.

8. That no new mills would be built in the West if Pittsburgh Plus were abolished.

9. That the only result of the abolition of this practice would be the impairment of existing investments in and about Pittsburgh and the enhancement of investments elsewhere.

10. That the abolition of Pittsburgh Plus would be productive of no general benefit to industry and would not affect the country's total production of steel.

11. That objectors seek only to benefit by obtaining greater profits for themselves at the expense of the mills and no consideration of the public.

12. That because of its long existence Pittsburgh Plus is a recognized factor in the steel trade and the steel industry would be in a chaotic condition if it were abandoned.

13. That the Pittsburgh market and Pittsburgh Plus exist because of Pittsburgh's advantages as a point of production and distribution.

14. That the practice does not discriminate against competitors or restrain competition and is therefore legal and unassailable.

THE DISSENTING OPINION

In his memorandum of dissent against the decision of the Commission, Nelson B. Gaskill presents the main contentions as follows:

1. The United States Steel Corporation is the dominant factor in the steel industry of the United States and that through Pittsburgh Plus.

2. Its subsidiary companies enjoy controlling advantages over their competitors in the matter of prime cost of raw materials and delivered cost of finished products.

3. The normal development of the steel industry in respect of location has been retarded and that industry unduly concentrated.

4. The development of a properly disseminated fabricating industry has been very seriously obstructed if not reduced to a permissive basis.

5. The uneven development of the steel industry and that of its fabrication works a grave hardship to many sections of the country.

Mr. Gaskill is of the opinion that these propositions are not to be lightly disregarded and that he is not to be understood as having decided adversely to them.

He says that the law does not require absolute freedom of competition, nor does it enjoin the observance of sound economic principles and that the Federal Trade Commission has not been given a mandate to establish any more than the other.

The Commission, he states, has to do solely with the legal concept of competitive requirements however short that may be of the true standard. In his opinion, if the laws permit the use of unsound economic principles, it seems that this tolerance is the act of the body of citizens themselves and must continue until a clearer understanding is demonstrated in terms of a legislative declaration.

Concluding his memorandum of dissent, Mr. Gaskill states: "Moreover it seems to me that the effort to apply a remedy through the Federal Trade Commission act confuses the issue. If the economists are right, the requirements of the situation will be met only by a legislative recognition of the necessity for a more exact statement of the scientific relation between business and economics and the declaration of that relation in the form of a law of general application.

The decision of the Commission is now being studied by attorneys for the Steel Corporation. It is reported that the Corporation's attitude will be one of non-compliance until the exact jurisdiction of the Commission can be determined or the case taken into court.

Business Briefs

Call money remained at 2 per cent, July 28.

Time loans for short terms, 2½@2⅝ per cent; longer periods, 3@3¼ per cent.

Commercial paper, best names 3¼@3½ per cent; other names, 3¾ per cent.

Foreign exchange (Demand):

	Normal	This Week	Last Week	Year Ago
Sterling	$4.8665	$4.39¼	$4.39	$4.57½
Franc	0.193	0.0508	0.0516½	0.0582
Lira	0.193	0.0433	0.0432½	0.0434

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 57 to 70, are the following:

Hotel, Chicago, Ill., for Hotel Sherman Co., $7,000,000.

High School, Waterbury, Conn., Bd. of Educ., $1,500,000.

Store, Bridgeport, Conn., D. M. Reed Co., $1,000,000.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 57 to 70, are the following:

Subway, Philadelphia, Pa., to Keystone State Constr. Co., $14,215,100.

Bridge approaches, Philadelphia, Pa., to American Bridge Co., $3,305,500.

Plant, Troy, N. Y. to Foundation Co., $2,500,000. Additional contract $1,000,000.

Roundhouse, Binghamton, N. Y., to F. D. Hyde Co., $2,250,000.

Massachusetts Leads in Demand for Edge-grain Pine Flooring

Of the 2,132,429,000 ft. of Southern pine lumber, all grades, shipped during 1923 from 102 mills (members of the Southern Pine Association) in Louisiana, Texas, Arkansas, Mississippi, Alabama and Florida, 354,079,000 ft. or 16.6 per cent was edge-grain and flat-grain flooring. About 16.4 per cent of the 1922 shipments was also flooring.

Edge-grain flooring took 53,244,000 ft. or 2.5 per cent of all stock, while shipments of flat-grain amounted to 300,835,000 ft. or 14.1 per cent.

Massachusetts led all states in the consumption of edge-grain flooring while Texas took the lead in demand for flat-grain.

The ten ranking states in each item, and their percentages of consumption, were as follows:

Edge-grain, Massachusetts, 13.9; New York, 11.6; Pennsylvania, 6.4; Texas, 5.8; Connecticut, 5.8; Illinois, 5.7; New Jersey, 5.0; Iowa, 4.7; Louisiana, 3.3; Missouri, 3.2.

Flat-grain, Texas, 9.4; New York, 9.4; Ohio, 9.1; Pennsylvania, 8.7; Illinois, 8.4; Alabama, 7.9; Louisiana, 5.6; Missouri, 5.1; Indiana, 4.8; Tennessee, 4.6.

Next week will appear an article on unit prices bid on materials in place on highway contracts during past month.

Where Construction Is Heaviest —South Leads Other Sections

Construction work for the United States during the first six months of the present year is 0.71 per cent heavier than for the same period of 1923, according to *Engineering News-Record* statistics. The construction contracts from which these statistics are compiled cover awards of $15,000 and over on water-works and excavation; other public works of $25,000; industrial buildings of $40,000 and above; commercial buildings of $150,000 and over (not including residential work). The totals for the first six months of 1924 and 1923 are $1,026,505,000 and $1,019,230,000, respectively.

Construction is holding relatively high rates in the Southern, Western and Middle Atlantic sections. Substantial increases in these sections are shown month by month over their records of last year with the exception of one month each. The Southern section fell below in June, the Western in March and the Middle Atlantic during the month of April.

The Southern states show the greatest increase in construction for this six month period compared with that of last year or with any of the other sections. The increase is 26.6 per cent making the 1924 half year total $117,623,000.

The Middle Atlantic section is 16.5 per cent greater than last year with a half year aggregate of $321,035,000. While the City of New York has had an unprecedented building period yet the increase of this section cannot be accredited to that of the city alone as the statistics show that construction work has been active throughout the section.

The Middle West shows the greatest reduction in construction, falling 30.9 per cent below the 1923 period. The 1924 six month figure for this section is $210,190,000. West of the Mississippi total of $163,850,000 is 12.1 per cent short of the 1923 figure. New England is 6.1 per cent under the same period of last year with its total of $61,278,000.

Most of the classes of construction show an increased money value of awards for this six month summary. The most active ones are: sewers, bridges, excavation and irrigation, streets and roads, commercial buildings.

The month of July has shown a steady increase in construction week by week. This is not only true for the total money value but extends through the greater number of the construction classes — commercial building showing the greatest activity.

The accompanying tables show the percentage of increase of the two years compared, also the total money value of construction awards for the first six months of 1924 and 1923 for the United States and the different state groups.

	1924 per Cent over 1923	1923 per Cent over 1924
New England	...	6.1
Middle Atlantic	16.5	...
Southern	26.6	...
Middle West	...	30.9
West of Mississippi	...	12.1
Western	22.3	...
United States	0.71	...

ALL CONSTRUCTION IN THE UNITED STATES FOR THE FIRST SIX MONTHS OF 1924 AND 1923 BY SECTIONS

	Jan.	Feb.	Mar.	Apr.	May	June	Total
	1924						
	Thousand	Thousand	Thousand	Thousand	Thousand	Thousand	Thousand
New England	$21,667*	$4,886*	$9,503	$5,769	$9,358	$10,095	$61,278
Middle Atlantic	48,285*	61,400*	52,608*	46,203	67,556*	44,983*	321,035*
Southern	18,267*	19,340*	18,973*	20,614*	27,650	12,779	117,623*
Middle West	27,979	17,162	38,103	40,501*	54,498*	31,947	210,190
West of Mississippi	21,273	21,290	28,817	24,504	48,761*	24,205	163,850
Western	22,482*	25,884*	18,231	25,978*	31,962*	22,992*	147,529*
Total	$159,953*	$149,962*	$166,235	$163,569	$239,785*	$147,001*	$1,026,505*
	1923						
New England	$10,797	$3,546	$10,844	$13,627	$16,859	$10,193	$65,066
Middle Atlantic	37,648	32,433	52,520	58,149	50,418	43,357	274,525
Southern	10,146	11,481	15,734	17,936	23,813	15,373	94,483
Middle West	42,329	37,359	51,373	39,941	45,360	58,783	275,145
West of Mississippi	25,391	21,450	50,648	36,385	25,589	29,945	189,408
Western	11,367	16,096	20,676	20,735	30,793	20,936	120,603
Total	$137,678	$122,365	$201,795	$186,773	$192,032	$178,5871,	$019,230

* 1924 totals greater than 1923 totals

Value of contracts awarded in the United States and percentages of each class to the total for the first six months of 1923 and 1924.

	1924		1923	
	Value Thousand	Per Cent	Value Thousand	Per Cent
Waterworks	$34,654	3.37	$41,596	4.08
Sewers	31,835	3.12	30,168	2.96
Bridges	35,807	3.48	32,553	3.19
Excavation, irrigation, etc	11,528	1.12	8,923	.87
Streets and roads	224,910	21.92	178,594	17.53
Industrial buildings	105,232	10.25	149,322	14.65
Commercial buildings	480,899	46.84	465,498	45.67
Federal Government	19,221	1.88	26,996	2.65
Unclassified	82,419	8.02	85,580	8.40
Total	$1,026,505	100	$1,019,230	100

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of July 3, the next, on August 7.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.34	$3.80	$4.20	$3.10	$3.35	$4.10	$3.60	$3.60	$4.20
Structural rivets, 100 lb.	3.75	4.35	4.90	3.50	3.75	5.15	5.00	4.25	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.24	3.30	3.38	3.00	3.25	3.87½	—3.35	3.50	2.70
Steel pipe, black, 2½ to 6 in. lap, discount	44%	—54 3/10%	43%	47%	55.05%	36%	36.80@49.10%	45%	47.43
Cast-iron pipe, 6 in. and over, ton	60.60@61.60	+53.00	58.50	56.20	58.50	68.00	59.00	65.00	65.00
Concreting Material:									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.20	2.42	2.84	2.61	2.90	1.90
Gravel, ¾ in., cu.yd.	1.75	—1.90	2.38	2.75	1.85	1.90	2.15	1.50	1.25
Sand, cu.yd.	1.00	1.40	2.00	2.75	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	2.00	2.83	3.00	1.75	3.50	2.15	3.00	2.25
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	57.00	36.00	57.20	57.00	38.75	36.75	32.00	22.00	60.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	18.00	25.50	24.00	22.60	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	—1.45	1.85	1.50	1.40	2.70	2.15	2.80	10.50
Common brick, delivered, 1,000	21.45@23.65	11.00	14.10	12.00	13.00	12.00	15.50	15.00	20.25
Hollow building tile, 4x12x12, per block	Not used	+.10	.11	.094	.08	.085	.....	.11	.12
Hollow partition tile 4x12x12, per block	.1162	+.10	.11	.094	.....	.085	.108	.11	.10
Linseed oil, raw, 5 bbl. lots, gal.	1.03	1.11	1.14	1.05	1.14	1.18	+1.11	1.13	1.01
Common Labor:									
Common labor, union, hour	.75	.30	.....	.87½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	....	.25	.30@.50	.82½	50@.55	.35@.50	.50	.62½	.25@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; lump finishing lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand stone, gravel and lump lime per ton. Stone, lime and tile are delivered; sand, gravel and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.67). Bag charge is .80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in. $119.

Conditions Affecting the Market

Improvement in business is evidenced by the following developments: (1) Better sentiment in the non-ferrous metal market with advances in most of the metals; (2) July has brought a week by week increase in contract lettings; (3) Advance buying in the copper market; (4) cement production, shipments and bookings are ahead of records of last year; (5) freight loadings continue to increase; (6) grain crops of west greater than expected with a much better price in view.

Linseed oil advanced in San Francisco. Douglas fir dropped $2 in Seattle while the demand shows a noticeable increase. Reinforcing bars dropped in San Francisco and hollow tile advanced in Atlanta.

Buying is still in small quantities but the general outlook is more hopeful. While there is a weakness in the steel market yet the immediate future looks brighter. The non-ferrous market has firmed as noted by the rise in the prices of copper, tin, lead and zinc.

It is evident from the advancing prices in some of the basic materials that buying is improving. Higher grain prices aid certain sections greatly.